ALLEN BRADLEY

SERVICE MANUAL

7/16/97

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EXIT Manual

Attention symbols

Some of the warnings, instructions and advice in this manual are so important that we used the following special symbols to draw attention to them:

Warnings

This symbol indicates a warning. Injury or even death may result if you do not heed it.
This symbol is also used to mark out safety components etc. See section ”Safety devices, a survey” in chapter ”Introduction” in the OPERATOR MANUAL or chapter ”Maintenance” in the SERVICE MANUAL.

Instructions

This symbol indicates instructions which are important, for example to prevent damage to the sterilizer and/or the load.

Advice

This symbol indicates important advice and hints that make it easier to work with the sterilizer.

GETINGE Castle

SERVICE MANUAL
TABLE OF CONTENTS

Attention symbols

1. FUNCTIONAL CHECK

Prior to Commissioning 1

2. MAINTENANCE

Safety devices, a survey 1
General 1
After commissioning 2
Air filter sterilization program. 5
Suggested Preventative Maintenance Schedule 7

3. GENERAL ADVICE

Manual interference in the sterilizing process 1
Manual stepping with key switch 1
Fault with an analog transducer 2
Manual control by actuating the control valves 3
Open the door manually 4

4. THE DOOR

General 1
Adjusting the door motion 2
Adjusting the door position 2
The door seal 6
Lubricating the door seal 6
Replacing the door seal 8
Replacing the door cylinder 8
Replacing the piston seal 9
Door safety arrangements 10
Blocking the start and opening the door 11
Emergency stop button 12

5. CONTROL UNIT ALLEN BRADLEY

Operating panel SLC 504 2
Push Buttons/Indicator Lights - Load Side 4
Push Buttons/Indicator Lights - Unload Side 5
Passwords 6
Detailed screen displays 7

Alarm and System Messages - Troubleshooting 26
System Interlocks - Horizontal Doors 36
Technical data 37

6. STERILIZER SPECIFICATION

7. P&ID DIAGRAM

8. ELECTRICAL WIRING

9. INSTALLATION DRAWING

10. PHASE LIST

11. COMPONENTS

Illustration on drawings 1
Panel-Mounted Thermal Printer, Model PRNTR0001 2
Vacuum pump LEM 60 7
Solenoid valve block 10
Piston valves 11
PT-100 Sensors (RTD) 12
Soldered plate heat exchangers 12

1. FUNCTIONAL CHECK

Prior to Commissioning

Prior to use, check that all service media are correct connected at their dedicated connection points.

- Check that all electric wire connection screws are tightened.
- Open the valves for compressed air, water and steam.
- Check the safety valves by lifting the lever when they are pressurized. Steam or air should blow out.

Use protective gloves. Blowing steam and hot lever can cause burns.

- Check for leakage on both supply and sterilizer pipes, for cabinet units remove the cover plates and panels.
- Check the door (doors) according to instructions given under the headline DOOR in the Service Manual.
- Check and, if necessary, adjust the supply of sealing water and leak air to the vacuum pump. See the *Vacuum pump* section in the COMPONENTS chapter.
- Perform all safety checks as described in the DOOR chapter.
- Check and adjust if necessary the air leak and sealing water flow to the vacuum pump.

Run all processes while checking pressure temperatures, times and function of signal lights. Set points will be found in the phase list. Save all Printouts for record.

2. MAINTENANCE

To be made by trained technicians only!

Safety devices, a survey

The panels of the sterilizer shall prevent the operator access to the inner parts of the sterilizer. Only specially trained personnel have access to the inner parts.

Safety components

Every sterilizer is equipped with a number of components the purpose of which is to specifically guarantee human safety. These items are marked with the sign below:

- Electric diagrams
- Piping diagrams

These components have been subject to special tests before being accepted as safety components and must therefore not be substituted by any make or execution not approved by Getinge/Castle, Inc. It is of greatest importance that these components are kept in good working order to maintain a safe function during the sterilizer life time. The signs are used not only to point out important components, but also to emphasize such other safety factors requiring special attention as measurements, tolerances, material etc.

General

Beware of the risks for squeezing, jamming, cutting and burning as well as the risks with electrical shock when removing and working behind the panels.

The demand for maintenance depends, above all, on the usage rate of the sterilizer. How often steps should be taken to prevent malfunction therefore will vary from case to case. We recommend the following maintenance to be performed at intervals stated for a sterilizer that is fully utilized.

After commissioning

After one month's operation, deposits and particles of dirt from new pipes will have collected in filters, strainers and other sensitive components. If they are not removed, they will result in reliability problems, leaks and reduced performance.

- Clean all strainers, including the filters, in the cold water, steam and drain lines.
- Check that all flow rates are correct, and rectify them if not.
- Clean all steam traps. Remove deposits on their seats and floats.
- Check that all pipe joints in the service supply and the sterilizer are tight.
- Check that all electric terminal screws are properly tightened, particularly on power connections.

Once a week

- Check that the door closing motion (vertical doors) can be stopped by gently pushing, the squeeze protection plate in the door opposite direction.

Monthly

- Check the door seal. If needed, lubricate as described in chapter Door.
- Check ink ribbon or pens of any printers or recorders and replace if necessary. Thermal printers do not require this routine maintenance.

After the first month of operation

- Clean all filters and strainers.
- Clean all steam traps.
- Perform a leak rate test using the appropriate program. See Operator Manual.

Every three months

- Overhaul as stated under *Monthly*.
- Check that the safety valve lead seal is intact.

- In case the seal isn't intact, the valve has to be replaced. Alternatively, call for an authorized person from the pressure vessel authorities, who will check the valve and seal it.

If the seals is broken, the set-pressure of the valve might have been manipulated. Autoclaves with broken safety valve-seals are not to be used.

- Sterilizers with safety valves for compressed air or water are checked by lifting the lever of the safety valve while having pressure in the chamber.
- Check that the safety valve is not leaking steam, air or water.
- Make a leak test using the appropriate program, as described in *Chamber Leak Test* in the Operator Manual.
- Check that the RTD Pt 100 is located in the center of the drain tube with the tip 70-75 mm below the chamber bottom or positioned in the flow of the drain piping.

Every six month

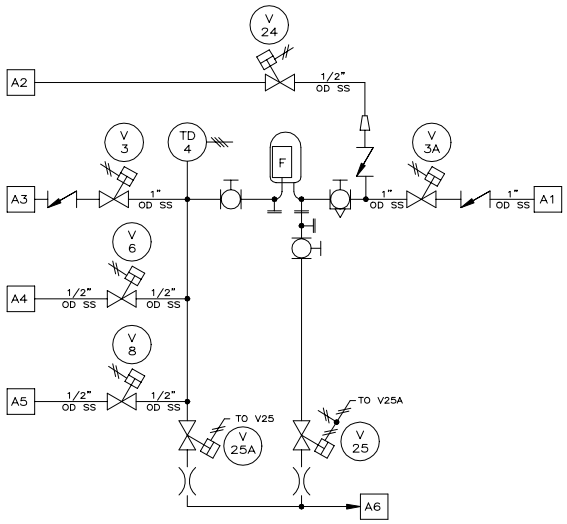
- Overhaul as stated under ”Every three months”.
- During a process the temperature and pressure sensors connected to the control system shall be checked against an independent system. For calibration of the sensors, see the CONTROL Chapter of this Manual.
  The pressure deviation, at 1 bar(a), may not be greater than ±10 mbar. For pressure above 1 bar(a) the deviation may not be greater than 0.01 x P(abs).
- Carry out the following measures following description under the heading *Door*:
  - Make the check as described in *Adjusting the door motion*.
  - Make the safety check as described in *Door safety arrangements*
  - Make the safety check as described in *Blocking the start and opening the door*.
  - Make the safety check as described in *Blocking the admittance of mediums to the chamber*.
  - Make the safety check as described in *Safety check, chamber pressure switch.*
  - Make the check as described in *Emergency stop button*.
- Replace the air filter. The filter should be changed more frequently if the air contains high amount of particles or humidity,

Once a year

- Overhaul as stated under *Every six months*.
- Make the check as described in *Checking and adjusting the door position.*
- Make the safety check as described in *Safety check, door seal groove pressure switch.*
- Check for leaks on pipe joints and fittings.
- Check that all electric connection screws are tightened.
- Clean all filters and strainers
- Clean all steam traps.
- Run all processes and check pressure, temperature, times and pilot lamp functions. Save all recorder diagrams from tests made.

Air filter sterilization program.

The sterilizer is equipped with a program for automatic in-line sterilization of the air filter.



LEGEND

- A1 – COMPRESSED AIR TO FILTER
- A2 – STEAM TO FILTER
- A3 – AIR TO CHAMBER
- A4 – AIR TO DOOR SEAL 1
- A5 – AIR TO DOOR SEAL 2
- A6 – FILTER DRAIN TO QUENCH SYSTEM

1. Valves 3, 3A, 6 & 8 will close, and valves 24, 25 & 25A open. The filter housing will be depressurized.
2. By operating valve 24, the system will be sterilized at 121 ^{o}C for 15 minutes. This is monitored by a resistive temperature detector, TD4.
3. After sterilization the system will be cooled down. This is done by closing valve 24 and opening valve 3A letting the compressed air cool the filter. Valves 25 and 25A remain open to enhance the drying. The drying cycle runs for 10 minutes.

Prior to removal of filter housing, internal pressure of the filter housing and piping must be relieved.

Service

Contact your local Getinge representative
or
Getinge/Castle, Inc.
Scientific Division

Service Department
Phone: 1-732-370-8800 Ext. 214
Fax: 1-732-367-7994

Spare parts

Contact your local Getinge representative
or
Getinge/Castle, Inc.
Scientific Division

Parts Department
Phone: 1-732-370-8666
Fax: 1-732-367-7994

Suggested Preventative Maintenance Schedule

	QUARTERLY VISIT:			
	1st	**2nd**	**3rd**	**4th**
Check door Reversal safety operation	[ ]	[ ]	[ ]	[ ]
Check door limit switches	[ ]	[ ]	[ ]	[ ]
Test 2 PSI chamber safety switch	[ ]	[ ]	[ ]	[ ]
Check & adjust doors to appropriate door gap	[ ]			
Check door seal regulator at 28 PSIG	[ ]		[ ]	
Check chamber temperature at sterilization +/- 0.5^{o}C	[ ]	[ ]	[ ]	[ ]
Check pressure transducer for correct readings and linearity	[ ]		[ ]	
Test gauges +/- 2 PSI (+/- 1 GMP)	[ ]	[ ]	[ ]	[ ]
Test vacuum pump operation & lubricate if applicable	[ ]	[ ]	[ ]	[ ]
Relubricate & rotate door seals		[ ]		[ ]
Replace door seals	[ ]		[ ]	
Test that safety valves lift at rated pressure	[ ]	[ ]	[ ]	[ ]
Adjust main compressed air regulator filter to 80 PSIG	[ ]	[ ]	[ ]	[ ]
Adjust door motor air regulator to 25 PSIG	[ ]	[ ]	[ ]	[ ]
Clean strainers	[ ]	[ ]	[ ]	[ ]
Check steam traps for leakage. Clean or replace if necessary	[ ]	[ ]	[ ]	[ ]
Check air admit filter for blockage (Non-biological test)	[ ]	[ ]	[ ]	
Change air admit filter				[ ]

Suggested Preventative Maintenance Schedule Continued:

	QUARTERLY VISIT:			
	1st	**2nd**	**3rd**	**4th**
Check retraction of door seal	[ ]	[ ]	[ ]	[ ]
Verify Controls:				
A. Check exposure/dry timers		[ ]		[ ]
B. Check all lamps and buttons		[ ]		[ ]
C. Check operation of load probes	[ ]	[ ]	[ ]	[ ]
D. Verify abort routine and Emergency stop activation		[ ]		[ ]
E. Verify program settings	[ ]	[ ]	[ ]	[ ]
Check valve operations/outputs	[ ]	[ ]	[ ]	[ ]
Test operation of cycles in accordance with program combination sheet	[ ]	[ ]	[ ]	[ ]
Check & adjust alignment of loading equipment				[ ]
Perform chamber vacuum lead test (HV units: <1”/hr or .035 BAR/hr)				[]
Check dip switch settings on mircoprocessors, printers	[]	[ ]	[ ]	[ ]
Check all cable & wire connection	[ ]	[ ]	[ ]	[ ]
Check for plumbing leaks	[ ]	[ ]	[ ]	[ ]
Polish exterior stainless panels	[ ]	[ ]	[ ]	[ ]
Check operation of utility switches if equipped	[ ]	[ ]	[ ]	[ ]

3. GENERAL ADVICE

Manual interference in the sterilizing process

When an error like supply medium or component failure occurs during a sterilizing process, the process may, after an alarm is emitted, get stuck in a phase from which the control unit can not go further.

The operator can, in some cases, restart the process by pressing the start/ restart button. If this isn't possible or doesn't solve the alarm, a trained technician must override the built in safety conditions by manual stepping.

Manual stepping with key switch

When stepping forward in a process program by means of the button C/ F9 after setting the key switch, all parameters are controlled by the automatic control unit whereby no dangerous situations can occur. The manually stepping means that the process goes from one process phase to another without time, temperature or pressure conditions being fulfilled.

For safety reasons, the possibility to go past a cooling phase or a pressure equalization is blocked, except in some cases when a fault with an analog transducer has occurred. Stepping should preferably be carried out with the process still in alarm phase and before restarting the process.

When stepping past a cooling phase or a pressure equalization, there no longer exists any blockages to prevent dangerous situations from arising. The technician himself has to decide which steps are to be taken.

The manual stepping must only be used by a technician who is well acquainted with the process, the properties of the sterilized goods and the function of the individual sterilizer components.

Fault with an analog transducer

Fault with an analog pressure transducer or temperature sensor stops a proceeding process. In case of a pressure transducer fault, the operator therefore has to step past the pressure conditions at post vacuum, evacuation, natural cooling and pressure equalization. With temperature sensor fault the operator has to step past the corresponding temperature conditions.

Fault with an analog pressure transducer or temperature sensor is indicated only once per process by the control unit.

Pressure transducer fault

Program with post vacuum.

- Step to the post vacuum phase.
  (NOTE! The process will perform a normal post vacuum. If a ramp is needed it has to be controlled by manually operating the vacuum valve.)
- When a required vacuum is reached, step to the pressure equalization phase.
- Raise the chamber pressure to atmospheric pressure by opening the valve to the air-in filter or the valve for support pressure. (Refer to *Solenoid Block* in COMPONENTS SECTION) Check the chamber pressure gauge.
- Step past the pressure equalization phase.
  (NOTE! possible only with pressure transducer fault)

Program with cooling

- Step to the cooling phase.
- Restart the process.
- Control the chamber pressure, by manually operating the solenoid valve for support pressure. When the load is cooled down, the process will automatically go to pressure equalization phase.
- Pressure equalize the chamber to atmospheric pressure by manually operating the solenoid valve controlling the Fast Exhaust drain valve. (Refer to *Solenoid Block* in Components Section) Check the chamber pressure gauge
- Step past the pressure equalization phase.
  (NOTE! possible only with pressure transducer fault).

Temperature Sensor fault

The process can be restarted if only one of the load sensors is broken. The process will then disregard the faulty sensor and go on from the point where the fault occurred.

Follow the instructions below if there is only one load sensor or more than one is faulty.

Program with post vacuum

- Step to the post vacuum phase.
- Restart the process.
- The process will be automatically ended.

Program with cooling

- Step to the cooling phase.
- Restart the process.
- Make sure that the load has been cooled down to a safe temperature when the minimum cooling time has expired.
- Step past the cooling phase
  (NOTE! possible only with pressure transducer fault)
- The process will end automatically.

Sensor fault, independent system

In case the process is stopped in a cooling or door opening phase, due to failure of the independent sensors, the safety system can be by-passed by manual operation of the safety relays.
See the electric wiring diagram.

Manual control by actuating the control valves

Manual actuating of control valves can be done when a system error occurs which keeps the process stuck in one phase.

When using this method, there no longer exists any blockages to prevent dangerous situations from arising. The technician himself has to decide which steps are to be taken.

The above captioned method must only be used by a technician who is well acquainted with the process, the properties of the sterilized goods and the function of the individual sterilizer components.

Open the door manually

The following, important steps, have to be taken into consideration before a door is manually opened

1. **Make sure, beyond all doubts**, that the valve you are going to manipulate is the correct one.
2. Drain the chamber from liquids that might flow out when opening a door by manually opening a drain valve
3. Relieve pressure from the chamber by manually opening a drain valve.
4. If sterilizer load consists of liquids, make sure that the temperature of the liquid is well below its boiling point.

Calibration

Analog sensors/transducers must be calibrated, for example when replaced.

When using an oil bath, note the following points:

A Accuracy must meet the specified requirements.

B Compounds or condensation in the oil may cause coatings and thus severely reduced the accuracy of measurement. Change the oil at regular intervals!

C Use an oil bath with a large capacity, preferably more than five litres.

D Allow the measuring instrument to stabilize for one to two hours after the bath has reached the set temperature.

E Allow the oil bath to stabilize for at least 30 minutes after the sensors are lowered into the bath and the bath has regained its set temperature.

F Clean the sensors thoroughly to remove the oil after calibration.

See the calibration menus section in the CONTROL UNIT chapter.

4. THE DOOR

General

The opening and closing motion of the door is executed by a pneumatic cylinder. As a safety measure there is a squeeze protection integrated in the top of the door.

When the door is closed, a mechanical lock will block the door. This lock activates a switch which makes it possible to pressurize the groove behind the door seal.

The doors are kept closed by the automatic control unit and the above mentioned lock while cycles are in progress and also when supply media fail. The doors do not open until the condition *chamber pressure = atmospheric pressure* is fulfilled, not even in case of an electric failure causing an opening command.

The door closing system comprises a number of parts and components which cooperate in a tested, safe way from personnel and material point of view. These items must not be subject to violence or improper influence of any kind which alter their initial function.

Adjustments on doors and associated equipment must be made by authorized personnel only.

Seal between door and chamber

The door seal is a continuous, thick-walled silicon rubber tube, movable in a groove and pushed against the door by means of steam, gas or air pressure. To enable for the door to move freely, the sealing tube can be sucked back from the door surface into its groove by a vacuum device.

Media to chamber

Before entering media to the chamber, all following requirements have to be fulfilled:

A Emergency stop not activated.

B Doors are closed.

C The door seals are pressurized.

D The control system gives signals for operating the media valves.

Adjusting the door motion

The door speed is controlled by a variable restriction in the air line supplying the door cylinder with compressed air. Changing the closing speed will result in a corresponding influence on the opening speed.

1. Adjust the restriction so that the door will close in about 15-18 seconds.
2. Check that the motion is even and free from jerks.
3. Check that the door does not scrape against closely situated metal components. Advise for corrections are given under the head line ”Adjusting the door position”.

Adjusting the door position

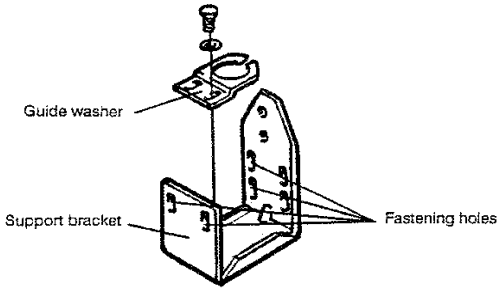
A. VERTICALLY

This adjustment becomes necessary if the distance between the top of the open door and the chamber bottom is not = 10 mm.

1. Measure the door adjustment required.
2. Lift away the door covering lower front plate after removing its two screws near the floor (see chapter INSTALLATION).
3. Close the door by activating its pilot valve by hand.
4. Lower and prop up the door until it rests upon the prop.

Make sure the door is resting securely on the prop!

5. Loosen the support bracket, adjust it in accordance with the measured requirements and tighten the screws.

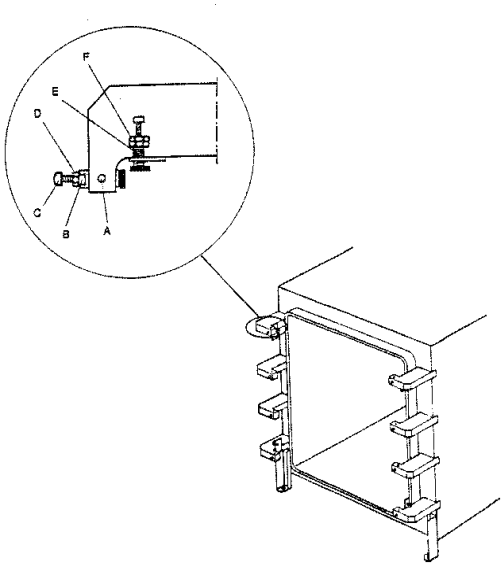


6. Pressurize the cylinder, remove the prop and lower the door. Check the level in relation to the sterilizer bottom.
7. Check that the closed door covers the door seal groove completely (small piston stroke margins).
8. Check that the upper end of the door is horizontal. When needed, move the lower end of the cylinder piston sideways after the attachment screws of the guide washer has been loosened. Tighten the screws when the washer is in correct position.
9. Assemble dismantled parts.

B. SIDEWAYS

10. Remove the front plates as described in the INSTALLATION chapter under the headline *Transportation*.

1. Partly loosen the side guide attachment nut F.
2. Adjust the door sideways by means of the screws E so as to form a clearance space to the guides of 23 mm.
3. The door should be symmetrically located in front of the chamber opening with the small deviations required for clearance to the trim plates.
4. Fasten the side guides upon completed adjustment.



C. AXIALLY

1. The clearance space between the door surface and the door seal groove should be about 2.5 mm.
2. Remove the front plates as described in the INSTALLATION chapter under the headline *Transportation.*

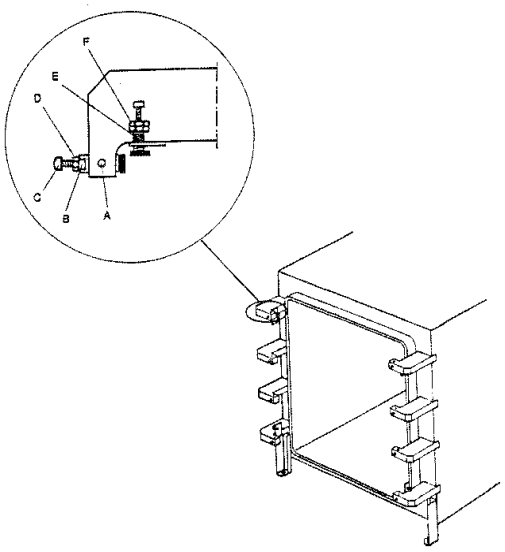
3. Partly loosen the locking screws A and the locking nut D.
4. If needed, loosen the screws B and insert a 2.5 mm thick plate strip between door and seal groove at each corner.
5. Adjust B until the plate strips are squeezed lightly between door and seal groove.

All screws have to be firmly tightened. The screws are an integrated part of the pressure vessel.

6. Tighten A and D.
7. Remove the plate strips.

Removing the door

1. Remove the lower front panel and both side front panels.
2. Place a prop or similar to stop the door about 150 mm from its end position when lowered.



Make sure the door is resting securely on the prop!

3. Lower the door.
4. Remove the air hose fitting from the foot of the piston end.
5. Loosen the eight nuts D and remove the screws C together with the two brass guides.

6. Lean the top of the door away from the sterilizer and lift it out. The weight of the door is approx. 75 kg (165 lb).

The door seal

The door seal is that part of the pressure vessel that is most exposed to wear and tear. The composition of the material, the design of the seal, its fitting and care are of extreme importance for reliable operation and long life of the seal. Getinge's door seal consists of a special silicone material, and its physical design is intended to make best use of its special characteristics.

Use only genuine Getinge door seals. Remember that each seal is an integral part of the pressure vessel.

Care

There are several negative factors that adversely affect the life of the door seal. By avoiding them as far as possible, the life of the seal can be considerably extended.

- Avoid leaving the sterilizer switched on in the standby mode during the night. Although the door seal material can withstand continuous temperatures of more than 200 °C, it slowly degrades where it is in contact with the seal groove. Leaving the sterilizer continuously energized will shorten the life of the seal by about 60 %.
- If the sterilizer has a steam generator, the generator must be drained at the prescribed intervals. Any feed water other than de-ionised feed water will gradually build up a concentration of minerals and other substances. At high concentrations, several of these substances are carried over with the steam and precipitated on the seal as weak acids.
- If the sterilizer is connected to a central steam system, the quality of the steam is decisive in determining the life of the seal. Chemicals are often added to the feed water for such purposes as protecting pipes against corrosion. Undesirable chemical characteristics of the steam include high hydrazine or carbon dioxide contents.
- Keep the seal lubricating layer intact and the sealing groove clean. The lubricating layer not only assists the seal in sliding, but is also an effective barrier against long-term chemical breakdown. See also under the 'Lubrication of the door seal' heading.

Lubricating the door seal

At delivery the door seal is prepared with a dry lubricant which results in a graphite grey appearance. The lubricating film has to be renewed in order to maintain the safe function of the seal. Renewal of the lubricating layer must not be made with the seal in place. Repeated spraying in

the groove will build up layers which eventually will cause the gasket to leak.

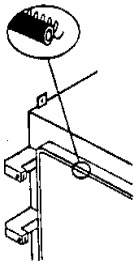
Disconnect the air supply or similar to make it impossible for the door to close while the work is carried out.

When applicable, see also chapter ”Special advice for sterilizer with automatic loader”.

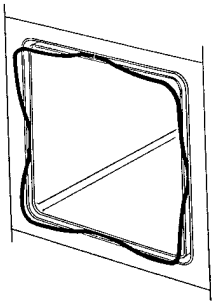
- Remove one of the safety plate screws and push the plate towards the empty screw hole until it becomes free at the opposite end (Vertical door system only).
- By means of a 6 mm allen-key, loosen the four cylinder attachment screws six turns each (Vertical Door System Only).

CAUTION! Do not tamper with the four smaller screws which have now become loose.

- Remove the gasket from the groove. Be careful with gasket and groove.
- Clean the groove of anything that may interfere with subsequent sealing.
- Clean the gasket with alcohol until its surface is felt absolutely smooth.
- Spray the gasket all over with dry lubricant, Dow Corning Molykote 321 recommended.
- Check that the helix is in place at the bottom of the groove.



- Press the gasket joint into the middle of the upper horizontal part of the groove.



- Press the middle of the gasket loop into the middle of the lower horizontal part of the groove and finally the middle of the two remaining loops into the middle of the vertical parts of the groove.
- Push the gasket into the groove. Always work towards the corners to make these collect the excess length of the gasket.
- Tighten the four cylinder attachment screws.
- Fit the safety plate by pushing it to the side with the missing screw, press it down and hook it up at the opposite end. Tighten the fixing screw and check the function.

Replacing the door seal

Proceed as described under *Lubricating the door seal* but skip sections concerning cleaning seal and spraying seal.

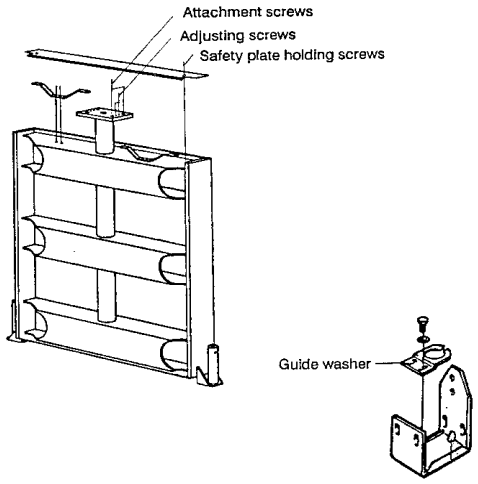
Replacing the door cylinder

1. Close the door by operating its air solenoid valve by hand.
2. Place a prop or similar to stop the door about 150 mm from its end position when lowered manual.

Beware of the danger of insufficient support

3. Remove the cylinder air hose fitting located on the piston stand and remove prop to completely lower the door.
4. Remove one of the safety plate attachment screws and push the plate towards the empty screw hole until it loosens at the opposite end.
5. By means of a 6 mm allen-key, remove the four cylinder attachment screws.

6. Prevent the piston from moving out of the cylinder by keeping the safety valve at its bottom closed (pulled out). Lift away the cylinder.
7. Attach the nipple and hose to the piston of the new cylinder.
8. Fit the cylinder into the door. Prevent the piston from moving out of the cylinder as described earlier or with a piece of string.
9. Attach it by means of the four allen-screws. With the four adjusting screws, make the cylinder align with the center line of the notches of the stiffening bars.
10. Attach the piston end guide washer in that position which makes the door move in the most proper way.



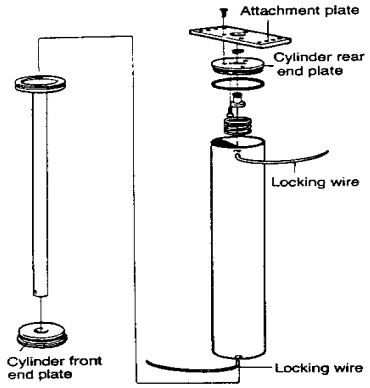
Replacing the piston seal

A worn-out piston seal can not be replaced as separate unit but the whole piston has to be replaced.

First perform ”Replacement of door cylinder”, section 1-7.

1. Fix the cylinder carefully in a vice jaw.
2. Remove the cylinder attachment plate.
3. Twist the cylinder end plate until the end of the locking wire appears in the locking wire hole.
4. Twist the cylinder end plate in that direction which feeds the locking wire out of the hole. The wire may need help from a tool to enter the edge of the hole.
5. Pull out the bent end of the locking wire from its driver hole.
6. Remove the cylinder end plate and replace its O-ring in connection with the replacement of the piston even if it appears to be free from damage.
7. Push out the piston and fix it in a vice jaw.

8. Protect the piston rod from tool marks with a piece of weak plate around its lower part, which is stiffened up by an insert piece of brass, while gripping there, but no where else, with a pipe wrench or similar tool.
9. Twist the piston rod to thread off. If sticky, apply heat carefully to soften the thread sealing compound. Clean the piston rod threads with a wire brush.
10. Apply ”Loctite 542" hydraulic sealing compound on the threads and screw the new piston on to the piston rod.
11. Assemble the cylinder and install it according to the points 8-11 under the head line ”Replacing the door cylinder”.



Door safety arrangements

Squeeze protection

The door motion is executed by a pneumatic cylinder the air inlet of which is considerably choked. An air exhaust valve having much larger flow capacity is arranged at the free cylinder end which is directed upwards. Any obstruction present during door closing exerts pressure on a plate running the entire length of the upper edge of the door at which this plate makes the exhaust valve open, thereby stopping the upward motion immediately. This will prevent personnel injuries and material damage.

Safety check

The safety check shall be performed in the early stage of the door closing operation. This reduces the risk for injuries due to squeezing.

1. Check that the air supply pressure is maximum permissible 8 bar (100 PSIG).
2. Open the door speed control valve entirely.

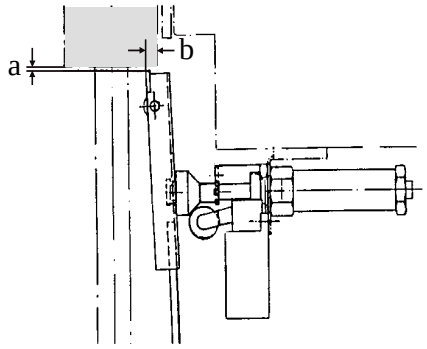
3. Close manually the door cylinder exhaust valve and open the inlet valve to make the door close.
4. Push downwards by hand and check that the plate moves freely. This enables the valve to open for a force on any spot of the plate without use of extreme force.

Blocking the start and opening the door

To prevent the door from opening by its own weight in case the pneumatic door cylinder should become depressurized, a brace underneath the door keeps it in closed position. The brace is brought in the stop position under the door by spring-force 20 seconds after a door closing command has been given. A limit switch senses the position of the brace thereby stopping the process from being started and mediums being admitted to the chamber before the door is completely closed.

Safety check

1. Check that the air pressure is minimum permissible 6 bar (80 PSIG).
2. Admit compressed air to make the door close.



3. Check that the measurement ”a” is 3-4 mm.
   Adjust the height of the brace when needed.
4. Check that the end of the brace is well within the cylinder circumference. (”b”= 12-17 mm)
5. Check by listening that the contact of the limit switch does not change over until the brace is safely under the pneumatic cylinder.

Beware of the danger of squeezing, while manipulating the brace.

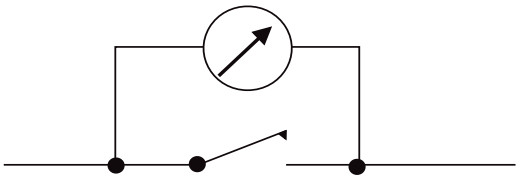
6. Check that the retaining pin is in place, preventing the limit switch operating cone from moving on the thread.
7. Operate the brace cylinder air valve repeatedly to check that the motion of the piston is smooth and free from jerks.
8. Check while the door is moving that it stops and remains stopped when pushing the EMERGENCY STOP-button.

Safety check, door seal groove pressure switch

A pressure switch senses the pressure in the seal groove and breaks the connection with those valves which control the admittance of steam, compressed air, water and gases whenever the seal groove pressure falls below the set point.

For double door sterilizers there are always two pressure switches, one for each door.

- Check the P&I diagram to identify and the pressure switch(es) for the door seal groove(s).
- Start a process.
- Stop the process using the main power switch, when full pressure is reached in the seal groove.
- Connect a measuring device (Ohm-meter) over the connection points of the pressure switch.



- Keep the sterilizer main power switch switched off. Due to condensation of steam, the pressure in the groove will decrease.
- Note the pressure at which contact change-over takes place. Right value shall be 1.9 bar(g) ± 0.1 (28 PSI).
- After the check, disconnect the measuring device.
- Switch the main power on and end the process (See section *Alarm* in OPERATION Chapter in the Service Manual).

Emergency stop button

When the emergency stop button is activated, the following functions are blocked:

- Media to chamber.
- Air supply for opening and closing door.

Further, the control system will enter the alarm phase.

Safety check

A Open a door. While the door is moving, press the emergency stop button. The door shall stop and the control system give an alarm. Reset the alarm and reset the emergency stop button. Open the door by pressing the ”open door” button.

B Close the door and start a sterilizing cycle.

C Press the emergency stop button when steam is entering the chamber. The steam valve shall close and the system shall go into the alarm phase. The printer (if connected) prints ”Process Stop” and the stop is indicated on the display of the control system.

D Reset the alarm and reset the emergency stop button.

E End the sterilization cycle.

In case above described functions do not work according to the description, let a well trained technician check the system.

F Make above safety check also for emergency stop button at the second door.

5. CONTROL UNIT - ALLEN BRADLEY

The object of the control system is to produce commands and transmit information to the sterilizer components enabling for a number of sterilization processes to be accomplished in accordance with a predicted pattern. The command signals are generated by the control unit computer program in combination with measurements of the process parameter values. The latter consist mainly of times, temperatures and pressures.

Various equipment can be connected to the control unit for programming, monitoring and recording the sterilization processes.

The operator communicates with the control unit via a control panel. The entire process is controlled by an Allen Bradley SLC 504 microprocessor control system.

The Allen Bradley SLC 504 control system is made up of the Control Processing Unit (CPU) and a Panelview504 Operator Interface Panel. This panel contains status indicator lights and display while serving as the operator interface for cycle selection and cycle parameter input. Visual indication of the process appears as a read-out on the display.

Documentation of programs, system definitions and process data can be made by connecting a printer. A host computer can also be connected direct to the control unit CPU.

The computer contains a program section for calibration of temperature and pressure transducers. Correction constants, when known, may be entered manually. Among available test functions there are facilities for activating analog and digital outputs and monitoring analog and digital inputs. The maximum programmable digits are 9999.

The hardware of the sterilizer control system contains the operating panels easily locate in a suitable place. The CPU and power pack are placed in a separate electrical enclosure, connected to the operating panels.

Some terms of the branch

STERILIZATION means the whole series of treatments to form a process in order to attain total killing of all viable organisms. This is in connection with autoclaves usually made up by air removal, heat treatment and a drying phase.

STERILIZING means the actual killing part, the heat treatment, of the total process.

Analogous to the two expressions above, STERILIZATION TIME means the durability of the total process from the start until the goods can be unloaded. PROCESS TIME is equal to sterilization time.

STERILIZING TIME represents that part of the process only during which the programmed STERILIZING TEMPERATURE prevails in the chamber.

PARAMETER in this context means the ELEMENTS WHICH INFLUENCE the sterilization course. Examples of parameters in the sterilization process are temperature, pressure, time, gas concentration, etc. The PARAMETER VALUES may be fixed in the program or operator adjustable.

F_0-VALUE is a time defined by the equation

$$F_0 = \int_0^t 10^{\frac{T_{(t)} - k_1}{k_2}} \times dt$$

t = Time in minutes

T(t) = Load temperature at time t

k_1 = Constant within the range 0.0 - 150.0 ^oC. Usually 121.1 ^oC

k_2 = Constant within the range 0.0 - 99.9 ^oC. Usually 10.0 ^oC

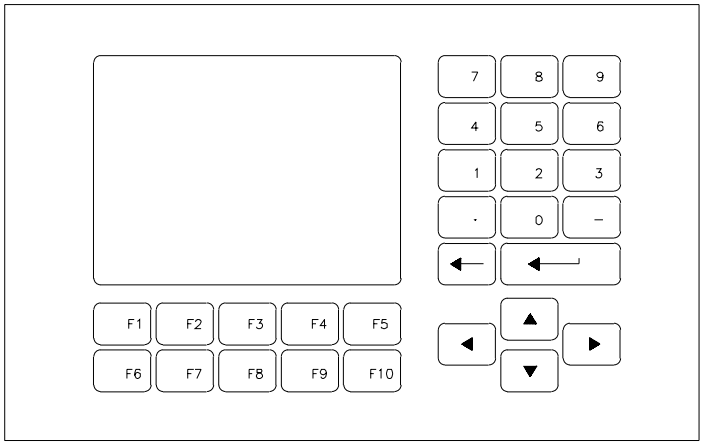
The F_0. value is based upon the sterilizing time, required for the temperature prevailing in each moment, being recalculated to the base temperature for steam sterilization, 121.1^oC

The use of F_0 value is most common in the pharmaceutical field, where often the time control of sterilization processes is based upon this value, thereby utilizing the heat applied during heating up and cooling down. By this method, heat sensitive products do not need to be exposed to high temperatures for a longer period of time than required in obtaining a sterile result.

Operating panel SLC 504

By means of the SLC 504, the operator selects program, alter parameter values, starts and monitors the processes and receives information about possible errors occurring with the sterilizer.

The SLC 504 control panel will not allow for such programming of the cycle, such as making new processes or altering programs already resident in the CPU.



Display

The 256 x 128 pixel display is the liquid crystal type. The backlight is field replaceable to extend the life of the terminal.

Front Panel

The SLC 504 control panel consists of multiple touch keys for operator interface.

- Numeric keypad with decimal and underline.
- Function keys for F1 through F10 selection.
- Scroll arrow keys to move the cursor left or right ←→ and up or down ↑↓.
- ENTER key ↵.
- Backspace key ←

Rear Panel

The back of the SLC 504 control panel contains two I/O Terminal Ports.

- Remote I/O port to connect a remote I/O Network.
- RS-232 port allowing connection to a RS-232 port of a computer for information transfer.

Push Buttons/Indicator Lights - Load Side

Emergency Stop/ Abort	This push button is used to discontinue a cycle. Once depressed, the outputs of the control system will be turned off disabling the sterilizer. At this time, a key must be used to unlock the emergency stop button. To unlock the emergency stop, turn the key. The button will move outward to reset. The operator must then acknowledge the alarm via the function keys located on the Allen Bradley display.
Alarm Acknowledge	This push button is pressed to acknowledge any alarm prior to continuing or aborting a cycle. This push button is also used to acknowledge that the sterilizer is unloaded after closing the door on the unload side.
Control Power ON/OFF	This selector switch controls power to the OFF position, all digital outputs are turned off disabling the sterilizer. During normal operation, the switch should be in the ON position.
Open Door	This push button is used to open the sterilizer door after a cycle has ended. When illuminated, it signals to the operator that the door can be opened.
Close Door	This push button is used to close the door. It must be pressed and held the entire time that the door is in motion. The door will reverse to the open position if the button is not held.

Push Buttons/Indicator Lights - Unload Side

Emergency Stop/ Abort	This push button is used to discontinue a cycle. Once depressed, the outputs of the control system will be turned off disabling the sterilizer. At this time, a key must be used to unlock the emergency stop button. To unlock the emergency stop, turn the key. The button will move outward to reset. The operator must then acknowledge the alarm via the function keys located on the Allen Bradley display.
Alarm Acknowledge	This push button is pressed to acknowledge any alarm prior to continuing or aborting a cycle. This push button is also used to acknowledge that the sterilizer is unloaded after closing the door on the unload side.
Open Door	This push button is used to open the sterilizer door after a cycle has ended. When illuminated, it signals to the operator that the door can be opened.
Close Door	This push button is used to close the door. It must be pressed and held the entire time that the door is in motion. The door will reverse to the open position if the button is not held.
Cycle In Progress	This indicator light identifies the cycle is in progress.

Passwords

Six passwords exist in the Allen Bradley and consists of five digits 0000 - 99999. The password sections are:

- Parameters
- Cycle Start
- Cycle Time & Date
- Service
- Calibration
- Master Password

Passwords at delivery:

The passwords set in the control system is revealed in a special document delivered in a sealed envelope together with the sterilizer manuals.

Detailed screen displays

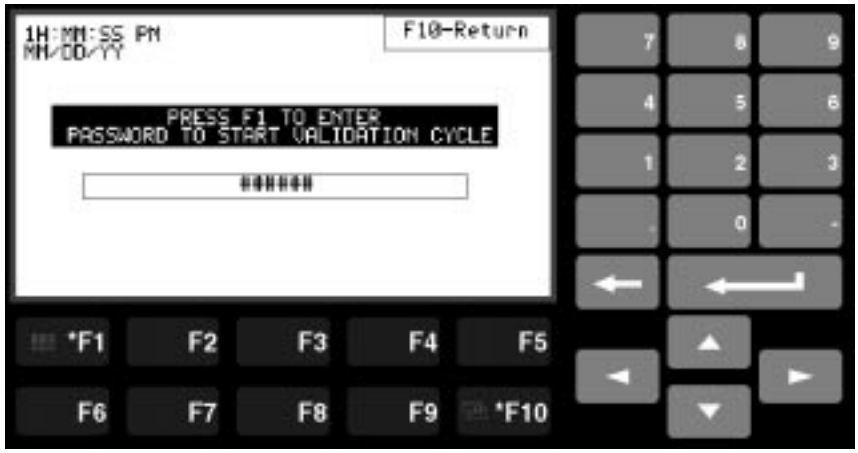
Main Menu

Upon start-up of the sterilizer, the main menu of the display will appear as shown below. Functions such as cycle selection, start cycle, runtime screen, change cycle parameters, alarms, and service information can be accessed through the main menu.

Us the up or down arrows located on the panelview keypad to select the next display frame. Press return to acknowledge and advance to the selected display frame.

Load Door Main Screen

This screen allows for the selection of the Validation Password Screen to allow the operation of a cycle from the opposite door. The correct password must be entered for the following displayed on the Unload Door.



Unload Door Main Screen

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GETINGE
MAIN MENU
CYCLE SELECTION
START CYCLE
RUNTIME SCREEN
CHANGE CYCLE PARAMETERS
ALARM SCREEN
SERVICE SCREENS
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
7
8
9
4
5
6
1
2
3
0

Cycle Selection/Start Cycle

In the Cycle Selection menu screen, select the type of cycle to be run by pressing the appropriate function key (F1, F2, etc.). The type of cycle selected will appear in the highlighted box. Press F5 to start the cycle.

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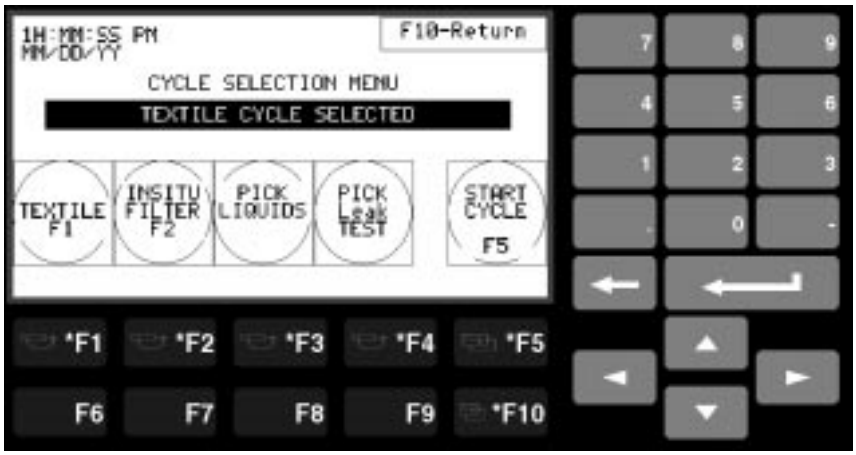

Cycle Start

The display will then ask the operator to verify start of the cycle. Press F3 to acknowledge the start of the cycle. The sterilizer's door will then be sealed and locked initiating the cycle.

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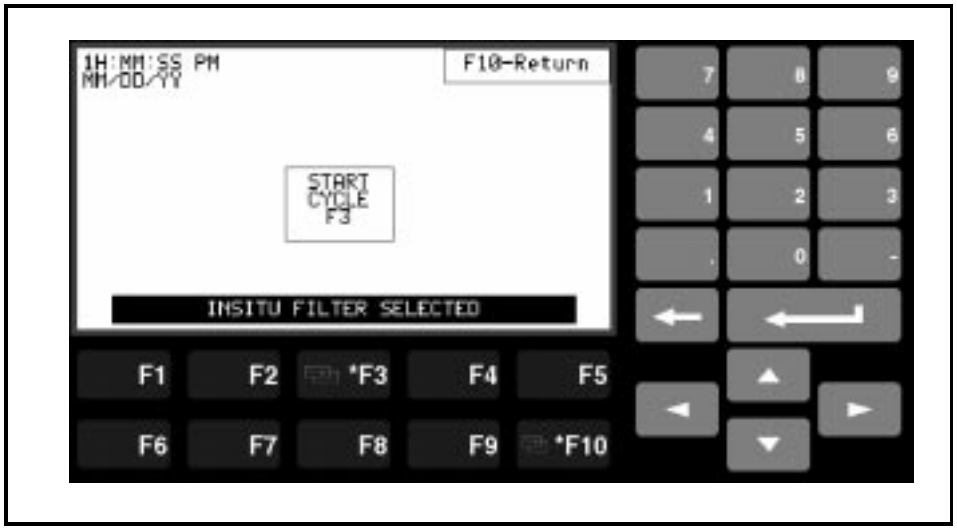
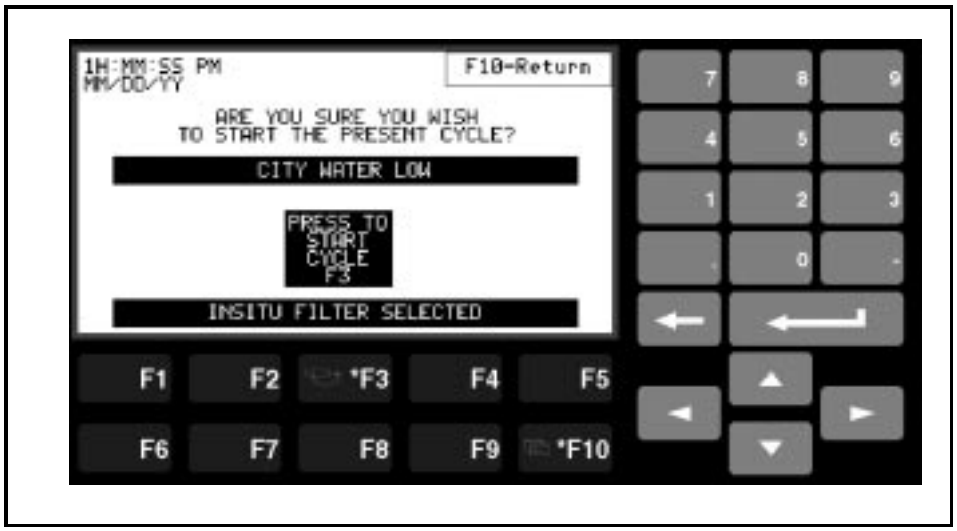


Following the selection of F3, the following confirmation screen will appear:



Runtime Screen

The Runtime screen allows the operator to observe the conditions during the sterilizer cycle such as temperature, pressure, etc. This display is accessed through the main menu via the up or down arrow keys followed by pressing the return button

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Cycle Parameters

The Change Cycle Parameter display screen is used to alter parameter setpoints of the cycle to be run such as sterilization time and temperature. This display is accessed through the main menu. Use the up or down arrow keys followed by pressing the return key to access this display. A password is required to access the Change Parameter display. Press F1 to enter the password. Enter the password using the numeric keys followed by pressing the return key.

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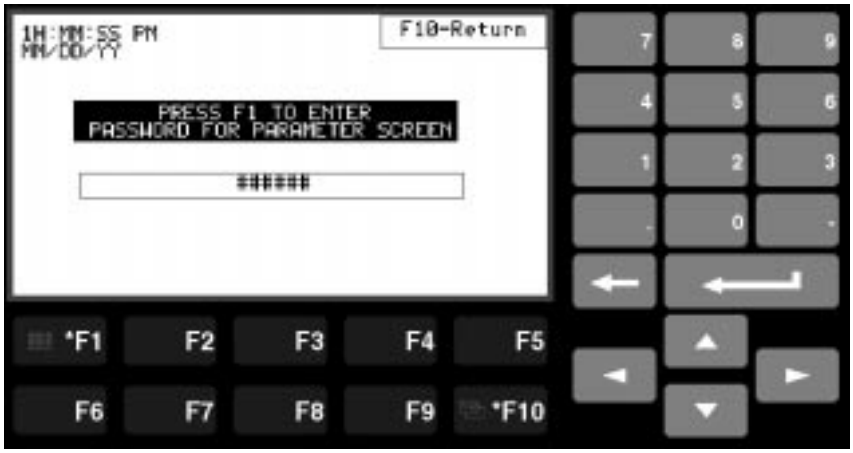

Select the cycle in which the parameters are to be altered. Use the up or down arrow key to select the cycle followed by pressing the return key.

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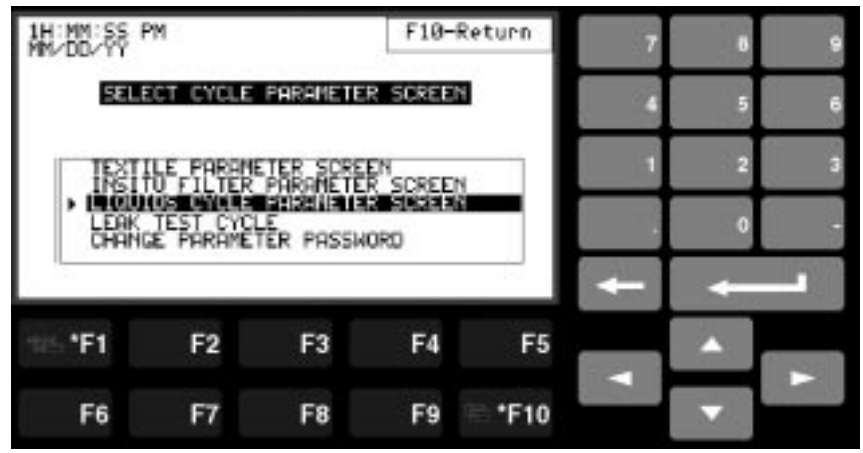

Change Parameter

In the Change Parameter display, the current parameter settings will be displayed. To alter a parameter, press the appropriate function key (F1, F2, etc.). Enter the parameter value using the numeric keys followed by pressing the return key. Decimal points are not required in entering the new value. A cycle may be started from this display screen by pressing F5.

Textile Cycle:

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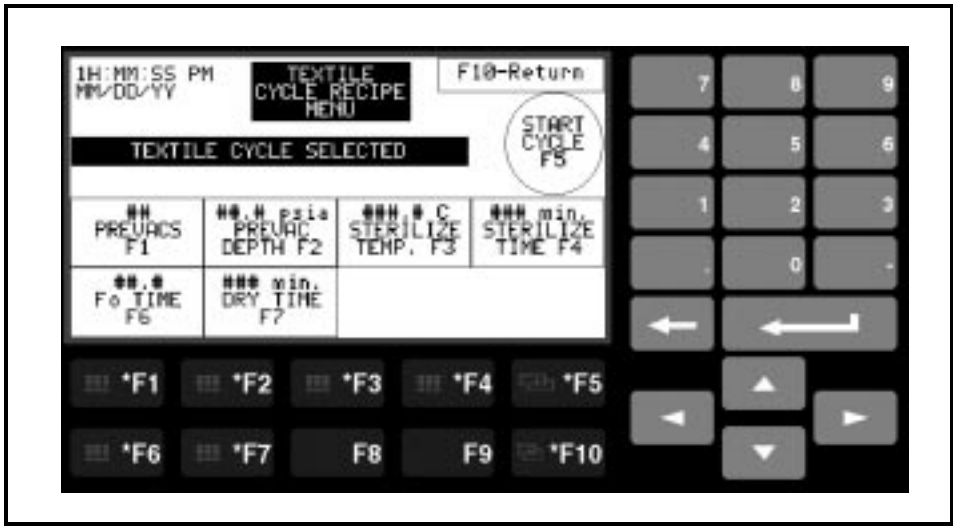

Insitu Cycle:

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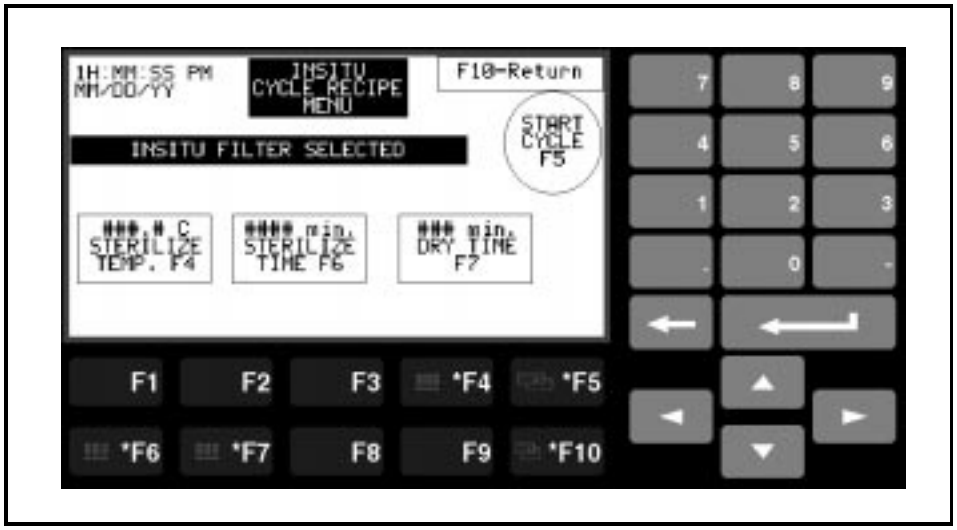

Liquid Cycle:

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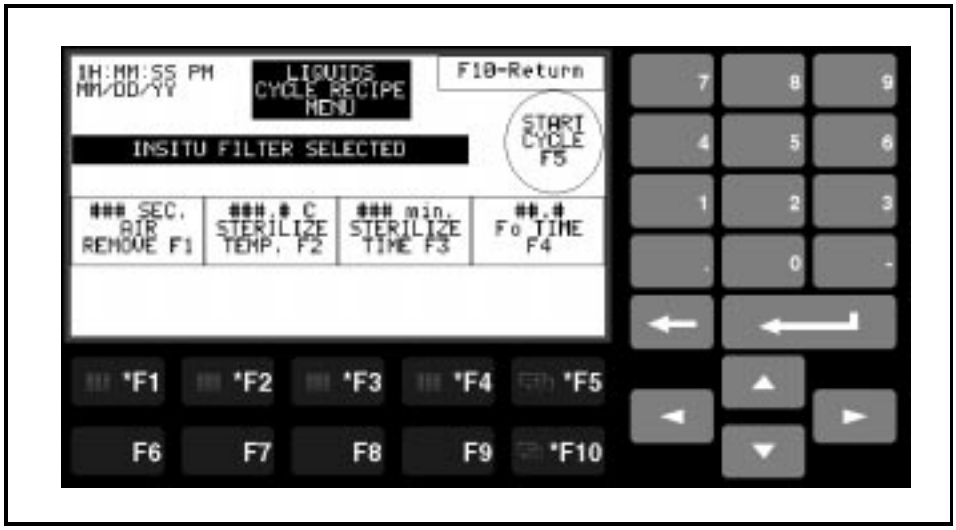

Leak Test Cycle:

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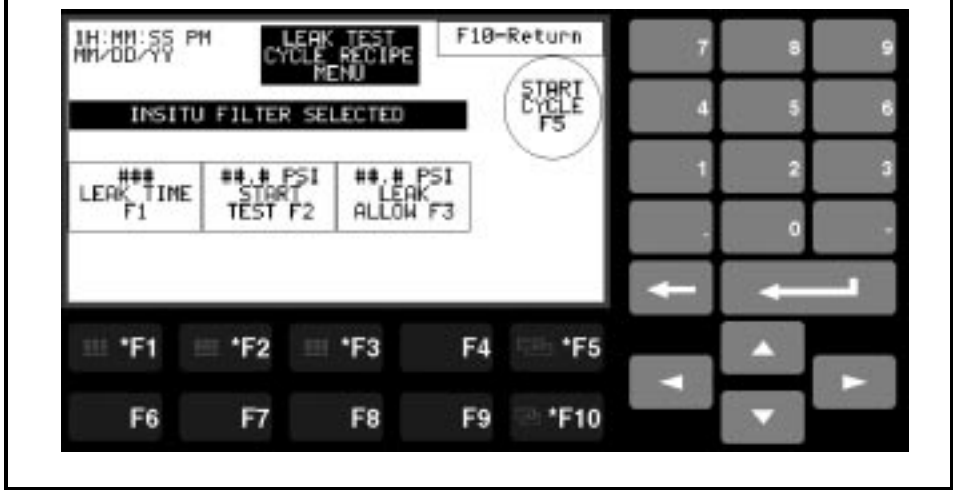

Parameter Password Screen

In the Change Password Screen, the operator can set or change the parameter password. To set or change the parameter password, press F1. Enter the password by using the numbered keys followed by pressing the return key.

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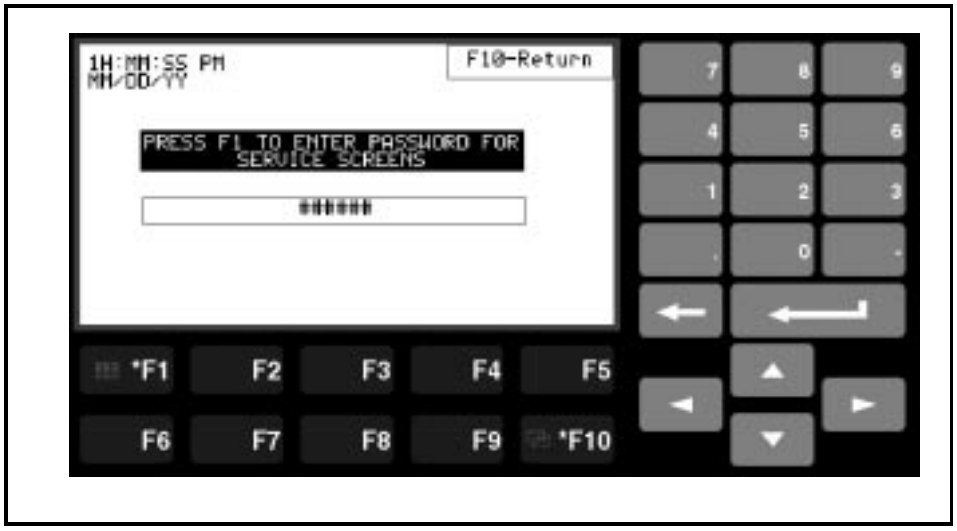
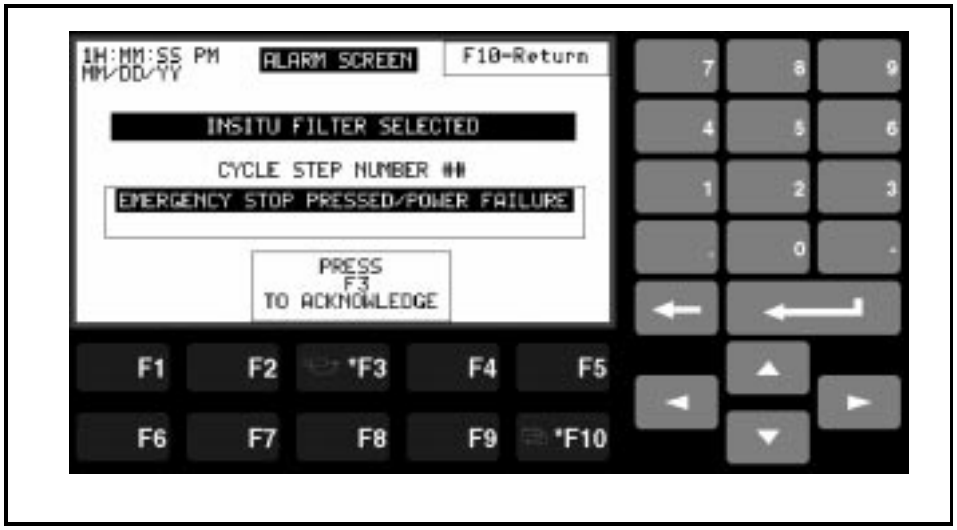
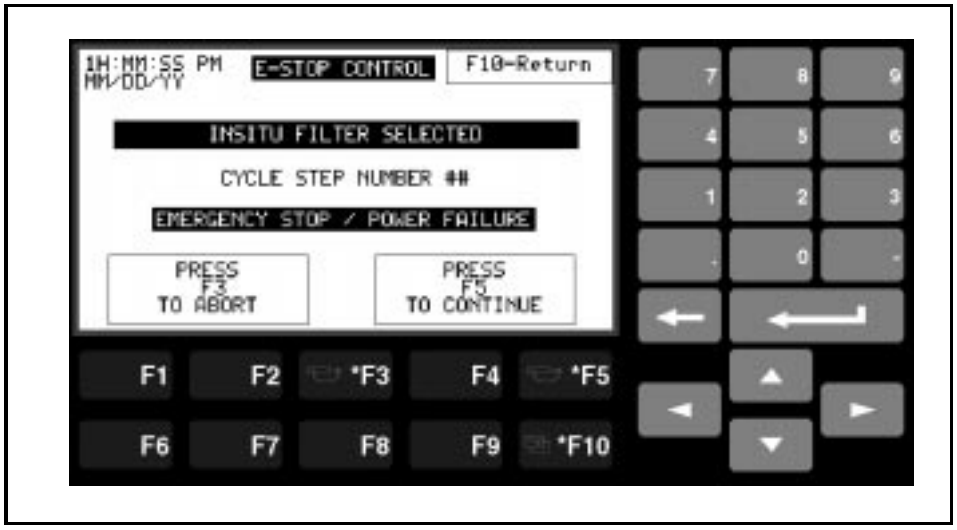


Alarm Display

In the event an alarm condition occurs during a cycle, the Alarm display screen will appear. The type of alarm will be displayed in the highlighted box. Any alarm or aborted cycle must be acknowledged to the control system. Acknowledge the alarm by pressing F3. The system will then ask the operator to continue the cycle or abort the cycle. Press F3 to abort the present cycle or F5 to continue the present cycle.

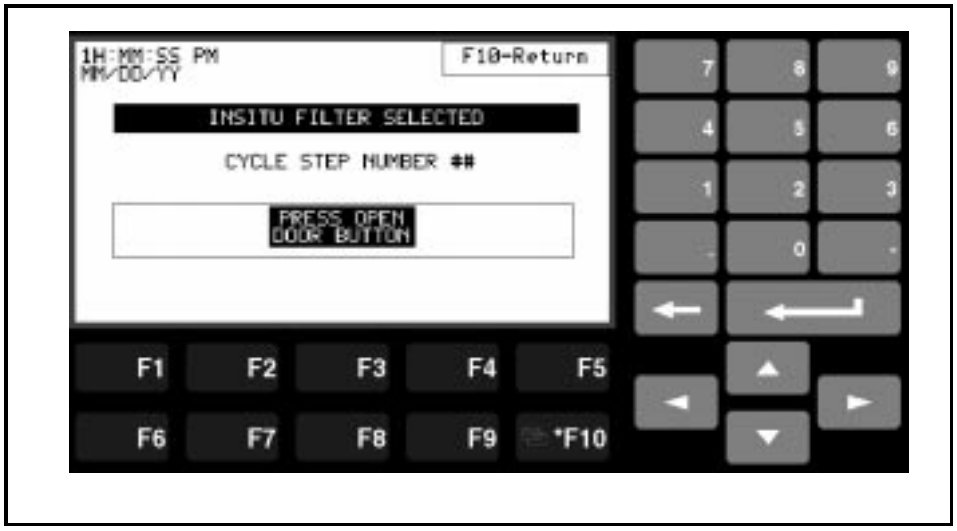


Emergency Stop Alarm Screen:



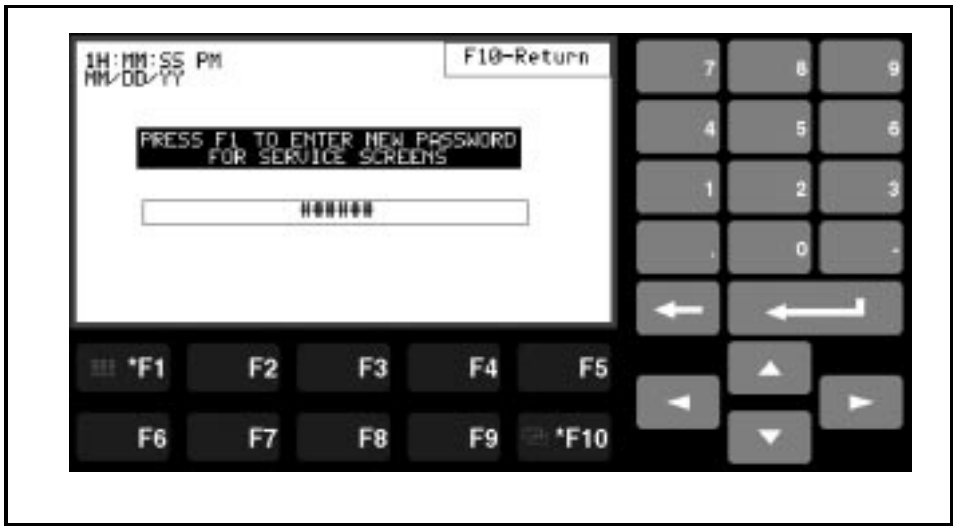
System Information

The System Information display screen will identify information about the cycle progress.

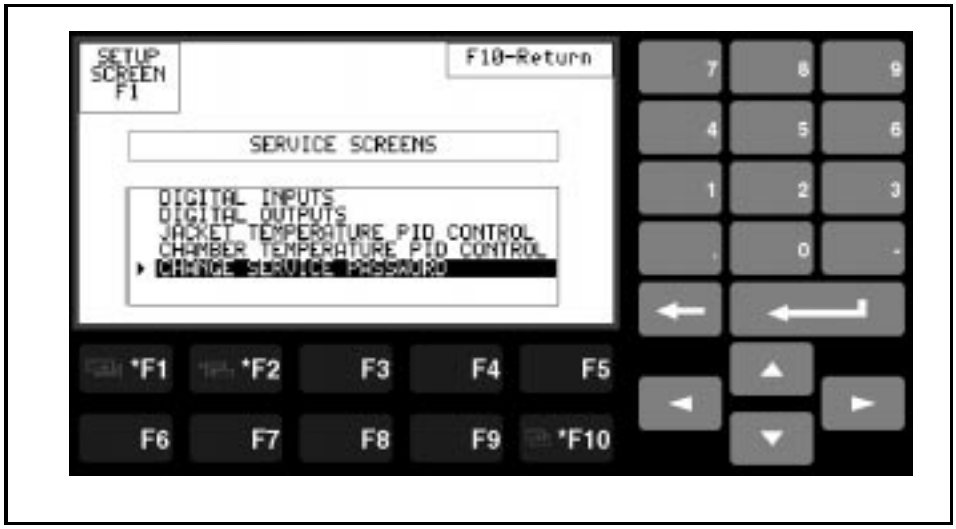


Service Screen

The Service display screen is used for service and maintenance functions such as monitoring control value, I/O checks and manual control of the sterilizers. The service display screen is accessed through the main menu by the use of the up or down arrow keys followed by pressing the return key. A service password is required to access the service display screens. Press F1 to enter the service password. Enter the password by using the numeric keys followed by pressing the return key.

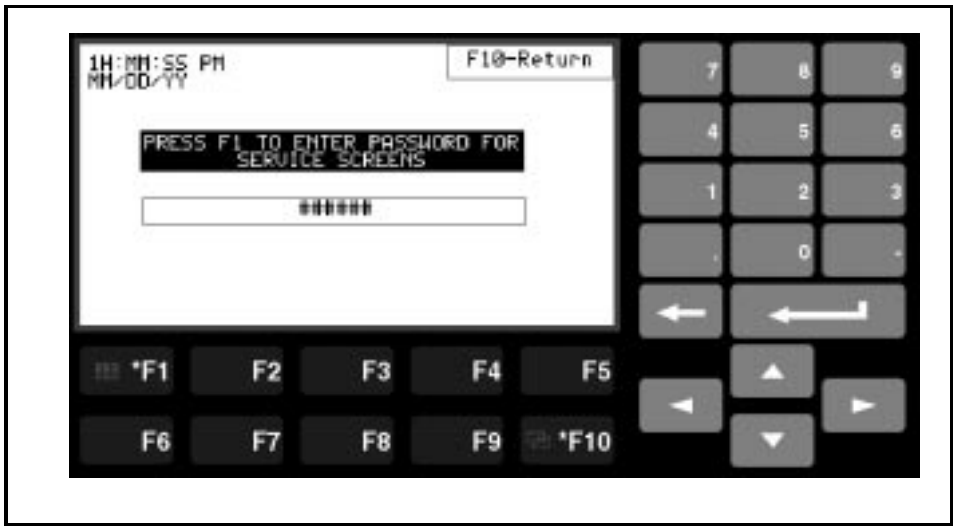


In the Service display screen, the up or down arrow keys are used to select the sterilizer components to be monitored and/or altered. Press the return key to access the display screens for these functions.



Service Screen Passwords

In this display scree, the user can change the service password. To change the current service password, press F1. Enter the new password using the numeric keys followed by pressing the RETURN key to enter the password. The system will then ask the user to verify the password. Re-enter the password followed by pressing the RETURN key.



Digital Inputs

In the Digital Input display, the user can observe the system's digital inputs as they are energized. An illuminated box indicates that the device is on and providing input to the controller.

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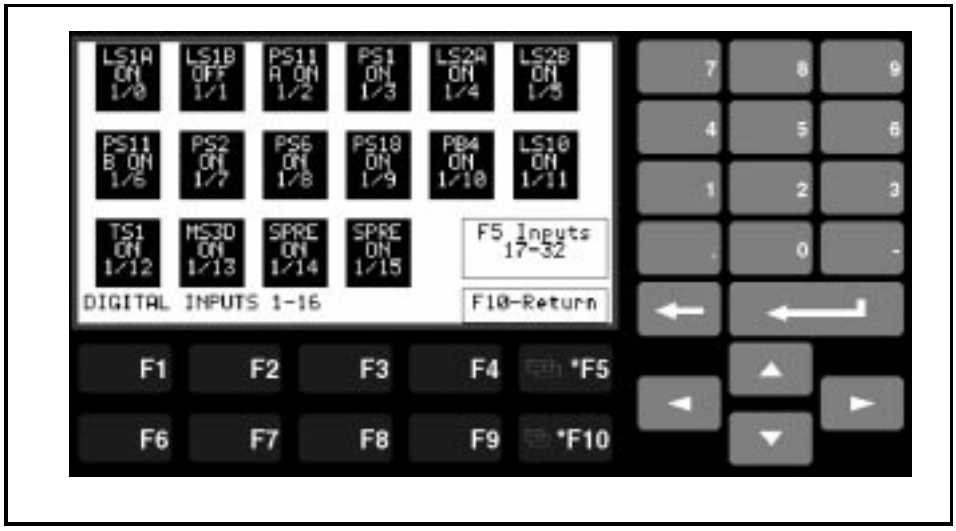
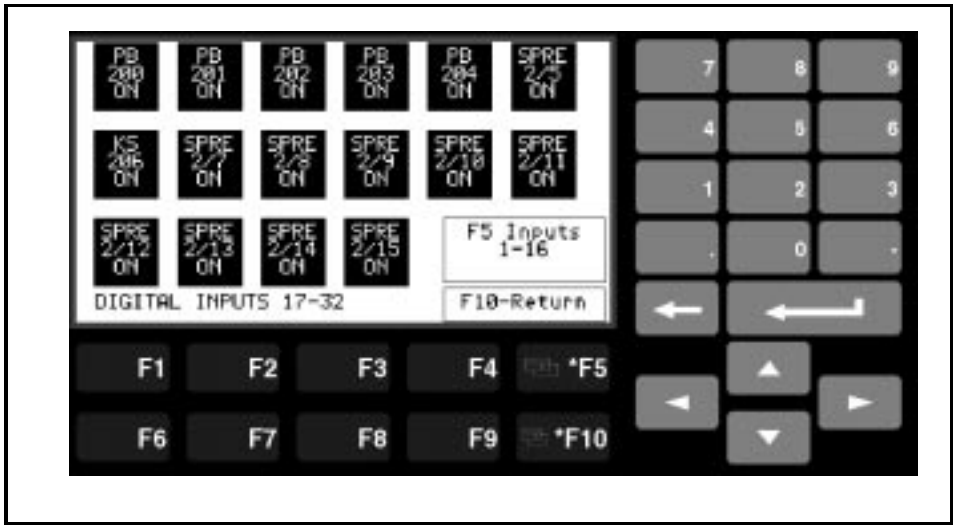
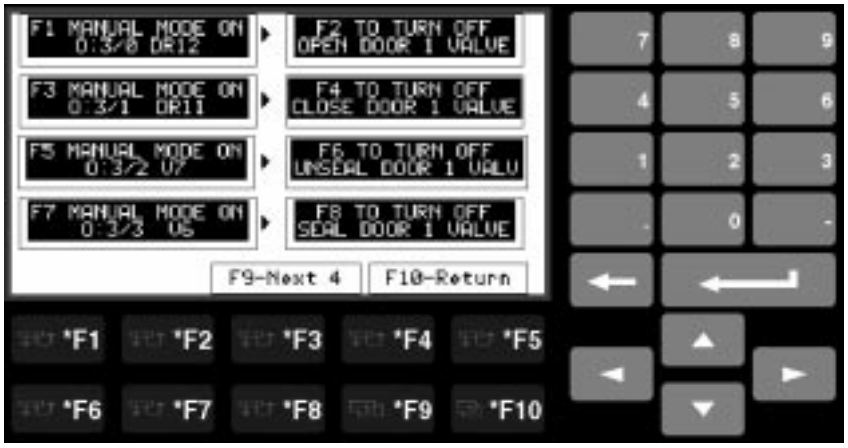




Digital Outputs

In the Digital Output display, the user can manually override devices, such as opening valves, once the device is in the manual mode. For each digital output display, the left-hand column and associated function keys will place the selected device in the manual mode when pressed. The right-hand column and associated function keys will physically turn the device on or off when pressed. An illuminated box represents the device in ON.



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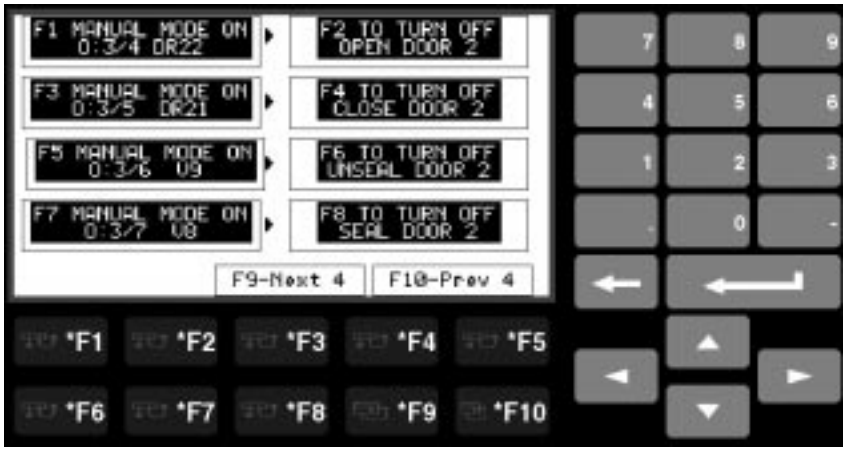

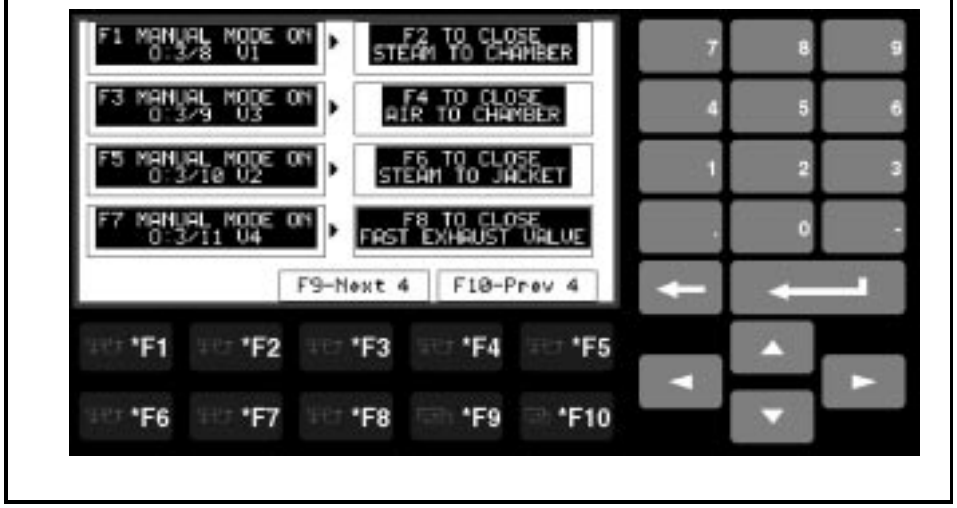
F1 MANUAL MODE ON
0:3/8 V1
F2 TO CLOSE
STEAM TO CHAMBER
F3 MANUAL MODE ON
0:3/9 V3
F4 TO CLOSE
AIR TO CHAMBER
F5 MANUAL MODE ON
0:3/10 V2
F6 TO CLOSE
STEAM TO JACKET
F7 MANUAL MODE ON
0:3/11 V4
F8 TO CLOSE
FAST EXHAUST VALVE
F9-Next 4
F10-Prev 4
*F1
*F2
*F3
*F4
*F5
*F6
*F7
*F8
*F9
*F10
7
8
9
4
5
6
1
2
3
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0
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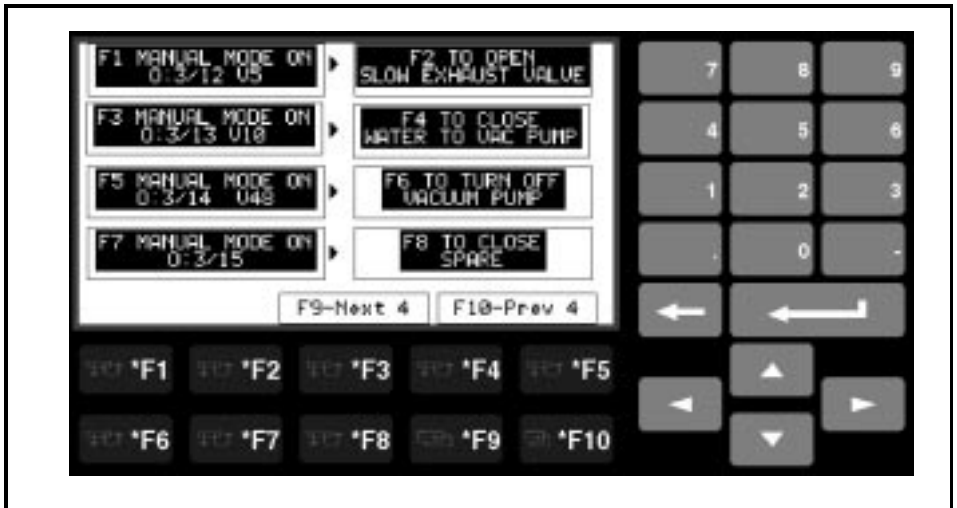
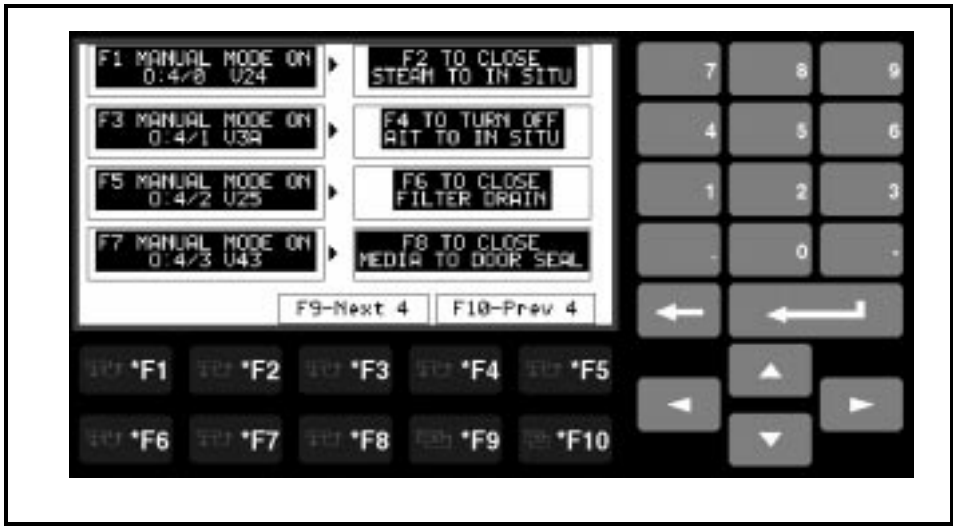
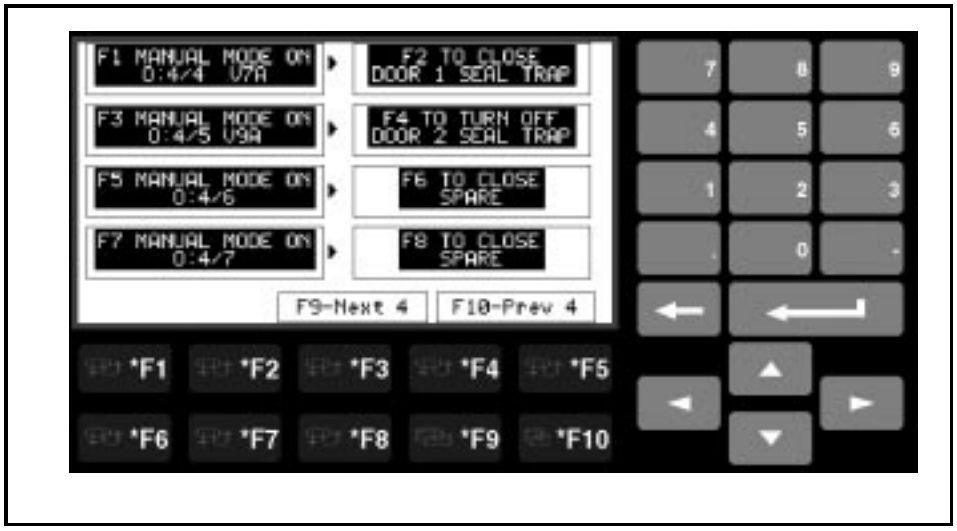

F1 MANUAL MODE ON
0:3/12 V5
F2 TO OPEN
SLOW EXHAUST VALVE
F3 MANUAL MODE ON
0:3/13 V10
F4 TO CLOSE
WATER TO VAC PUMP
F5 MANUAL MODE ON
0:3/14 V48
F6 TO TURN OFF
VACUUM PUMP
F7 MANUAL MODE ON
0:3/15
F8 TO CLOSE
SPARE
F9-Next 4
F10-Prev 4
*F1
*F2
*F3
*F4
*F5
*F6
*F7
*F8
*F9
*F10
7
8
9
4
5
6
1
2
3
.
0
-


F1 MANUAL MODE ON
0:4/0 V24
F2 TO CLOSE
STEAM TO IN SITU
F3 MANUAL MODE ON
0:4/1 V3A
F4 TO TURN OFF
AIT TO IN SITU
F5 MANUAL MODE ON
0:4/2 V25
F6 TO CLOSE
FILTER DRAIN
F7 MANUAL MODE ON
0:4/3 V43
F8 TO CLOSE
MEDIA TO DOOR SEAL
F9-Next 4
F10-Prev 4
*F1
*F2
*F3
*F4
*F5
*F6
*F7
*F8
*F9
*F10

.


F1 MANUAL MODE ON
0:4/4 V7A
F2 TO CLOSE
DOOR 1 SEAL TRAP
F3 MANUAL MODE ON
0:4/5 V9A
F4 TO TURN OFF
DOOR 2 SEAL TRAP
F5 MANUAL MODE ON
0:4/6
F6 TO CLOSE
SPARE
F7 MANUAL MODE ON
0:4/7
F8 TO CLOSE
SPARE
F9-Next 4
F10-Prev 4
*F1
*F2
*F3
*F4
*F5
*F6
*F7
*F8
*F9
*F10

.

F1 MANUAL MODE ON
0:4/08 CR408
F2 TO TURN ON
NO ALARM
F3 MANUAL MODE ON
0:4/9 LT409
F4 TO TURN OFF
DOOR 1 OPEN LAMP
F5 MANUAL MODE ON
0:4/10 LT410
F6 TO TURN OFF
DOOR 1 CLOSED LAMP
F7 MANUAL MODE ON
0:4/11 LT411
F8 TO TURN OFF
OPEN DOOR 2
F9-Next 2
F10-Prev 4
*F1
*F2
*F3
*F4
*F5
*F6
*F7
*F8
*F9
*F10
7
8
9
4
5
6
1
2
3
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0
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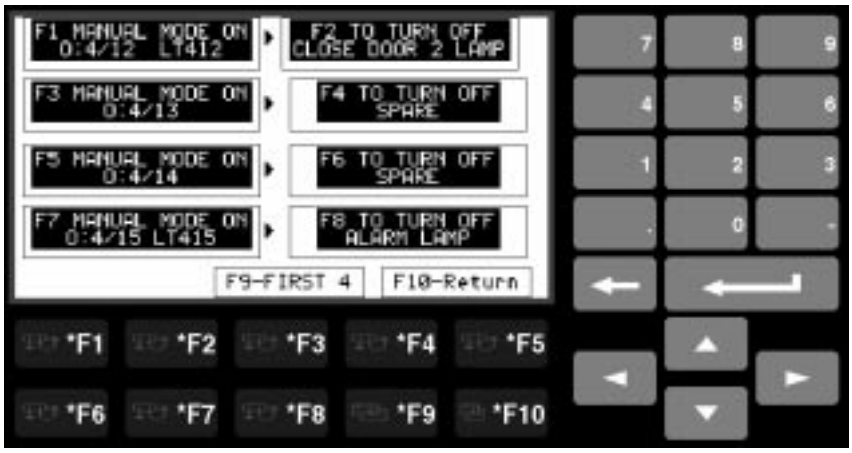
F1 MANUAL MODE ON
0:4/12 LT412
F2 TO TURN OFF
CLOSE DOOR 2 LAMP
F3 MANUAL MODE ON
0:4/13
F4 TO TURN OFF
SPARE
F5 MANUAL MODE ON
0:4/14
F6 TO TURN OFF
SPARE
F7 MANUAL MODE ON
0:4/15 LT415
F8 TO TURN OFF
ALARM LAMP
F9-FIRST 4
F10-Return
*F1
*F2
*F3
*F4
*F5
*F6
*F7
*F8
*F9
*F10
7
8
9
4
5
6
1
2
3
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0
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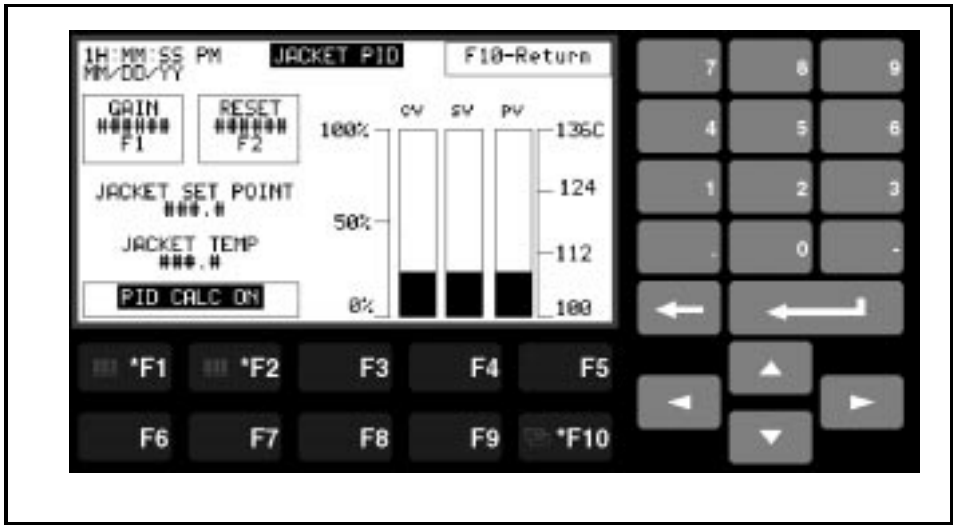
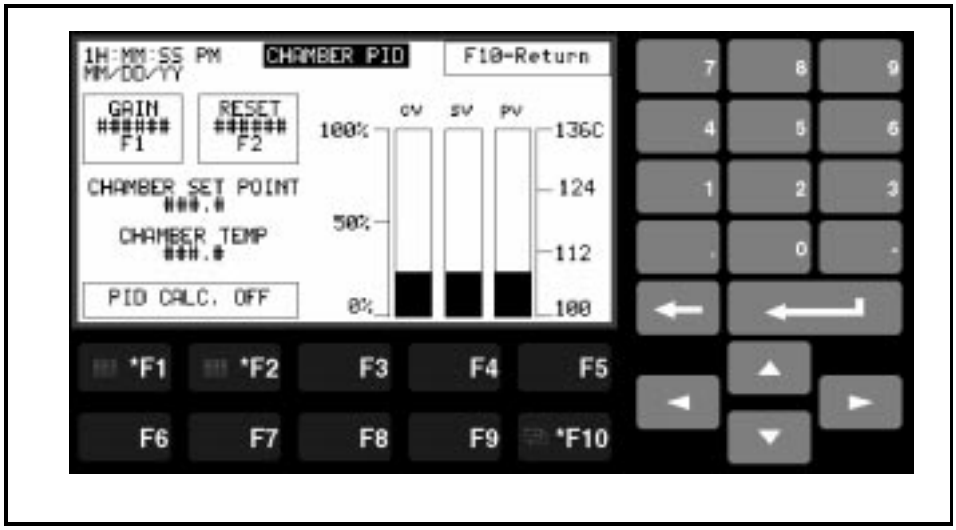
PID Control

In either the Jacket PID or the Chamber PID display screen, the user can observe the operation of the valve which controls steam to the chamber or jacket. The proportional gain and reset values used to maintain temperature control can be altered from this display. To alter one of the parameters, press the appropriate function key. PRess F3 to alter the PROPORTIONAL GAIN value or F2 to alter the RESET value. Enter the new value using the numerical keys followed by pressing the RETURN key to enter the value.

Jacket PID



Chamber PID



Alarm and System Messages - Troubleshooting

Note:

All alarms and system messages must be acknowledged to silence the alarm and clear the display. Fatal errors will interrupt the cycle. The cycle will not be interrupted when a non-fatal error occurs. Acknowledging the error will not interrupt the cycle. When troubleshooting, ALWAYS refer to the wiring diagram for the unit being serviced. Also see the Input/Output table in the Appendix.

SERVICE TO BE PERFORMED BY QUALIFIED PERSONNEL ONLY.

Information Text

The following messages are displayed on the display panel. Typically the “CYCLE RESTARTED” and “CYCLE ABORTED” messages will also be printed to the printer

CYCLE ABORT	This message will be displayed if, following pushing Emergency Stop button and then restoring the power, the operator elects to abort the current cycle by pushing the OPEN DOOR button. See Emergency Stop below.
SEALING DOOR #1	This message will be displayed on the display panel once all start conditions are satisfied and the start button is pressed. When Door #1 is fully sealed, the message is no longer displayed.
SEALING DOOR #2	This message will be displayed once all start conditions are satisfied and the Start button is pressed. When Door #2 is fully sealed, the message is no longer displayed.
UNSEALING DOOR #1	During the Cycle End phase, this message will be displayed as the Load Door is unsealed.
UNSEALING DOOR #2	During the Cycle End phase, this message will be displayed as the Unload Door is unsealed.
CYCLE COMPLETE	During the Cycle End phase, this message will be displayed after the chamber has returned to atmospheric pressure.
CYCLE RESTARTED	This message will be displayed if, following pushing the Emergency Stop button and then restoring the power, the operator elects to continue the current cycle by pushing the CONTINUE button on the Alarm Display. See Emergency Stop below.
UNLOADING	This message will be displayed during the Cycle End phase while the unload door is opened.
PRESS OPEN - LOAD	This message will be displayed during the Cycle End phase once the unload door has been closed again following unloading the Load Door may be opened.
OPEN DOOR	This message will be displayed during the Cycle End phase once the Load Door seal has been pulled and the door is ready to be opened.

Alarm List

EMERGENCY STOP

Message Display:

EMERGENCY STOP

This alarm is activated when the Emergency Stop pushbutton is activated from the fascia panel. All digital outputs except for the alarm and Acknowledge Alarm lamp will be turned off. The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the emergency stop alarm screen on the PanelView 900 operator terminal. The alarm will be printed if the unit is in cycle.

Operator Acknowledgement:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing, but remain illuminated. All outputs remain off.

The Emergency Stop button must be reset by inserting the key and twisting in the clockwise direction. The cycle may be aborted or continued by pressing the appropriate button area of the touch screen display. When a cycle is aborted, the sterilizer will advance to the post conditioning phase of the cycle allowing the sterilizer to advance to a safe condition. When a cycle is continued, the process will return to the condition at the point when the alarm was activated and continue the cycle.

CHAMBER TEMPERATURE SENSOR ERROR

Alarm Condition:

The probe is out of the allowable range of -5.0^{o}C to 150^{o}C

Message Display:

CHAMBER TEMP OUT OF RANGE

This alarm will turn off all digital outputs except for the alarm and Acknowledge Alarm lamp. The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present. All outputs remain off.

The alarm must be cleared by repair or replacement of the defective component. When the sensor returns to within the allowable range, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

PRESSURE SENSOR ERROR

Alarm Condition:

The sensor is out of the allowable range of 0 PSIA to 50.0 PSIA.

Message Display:

CHAMBER PRESSURE OUT OF RANGE

This alarm will turn off all digital outputs except for the alarm and Acknowledge Alarm lamp. The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present. All outputs remain off.

The alarm must be cleared by repair or replacement of the defective component. When the sensor returns to within the allowable range, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

INSITU FILTER TEMPERATURE SENSOR ERROR

Alarm Condition:

The probe is out of the allowable range of -5.0^{o}C to 150^{o}C

Message Display:

INSITU FILTER TEMP OUT OF RANGE

This alarm will turn off all digital outputs except for the alarm and Acknowledge Alarm lamp. The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present. All outputs remain off.

The alarm must be cleared by repair or replacement of the defective component. When the sensor returns to within the allowable range, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

LOAD TEMPERATURE SENSOR ERROR

Alarm Condition:

The probe is out of the allowable range of -5.0^{o}C to 150^{o}C

Message Display:

LOAD TEMP OUT OF RANGE

This alarm will turn off all digital outputs except for the alarm and Acknowledge Alarm lamp. The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present. All outputs remain off.

The alarm must be cleared by repair or replacement of the defective component. When the sensor returns to within the allowable range, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

DOORS NOT CLOSED

Alarm Condition:

The door limit switch input is on.

Message Display:

DOORS NOT CLOSED

This alarm will turn off all digital outputs except for the alarm and Acknowledge Alarm lamp. The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present. All outputs remain off.

The alarm must be cleared by repair or replacement of the defective component. When the repair is complete, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

DOORS NOT SEALED

Alarm Condition:

The door seal pressure switch reads low (off) for more than 2 minutes.

Message Display:

DOORS NOT SEALED

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present.

Check that required steam pressure is being supplied to the unit. The alarm must be cleared by repair or replacement of the defective component or providing required steam pressure. When the repair is complete, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

DOORS 1 SEAL LEAK

Alarm Condition:

The door 1 seal flow switch reads high for more that 20 seconds.

Message Display:

DOORS 1 SEAL LEAK

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present.

Check that required steam pressure is being supplied to the unit. The alarm must be cleared by repair or replacement of the defective component or providing required steam pressure. When the repair is complete, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

DOORS 2 SEAL LEAK

Alarm Condition:

The door 2 seal flow switch reads high for more that 20 seconds.

Message Display:

DOORS 2 SEAL LEAK

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present.

Check that required steam pressure is being supplied to the unit. The alarm must be cleared by repair or replacement of the defective component or providing required steam pressure. When the repair is complete, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

POWER FAILURE

Alarm Condition:

The processor detect there has been a loss of power.

Message Display:

POWER FAILURE

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will extinguish.

HIGH CHAMBER PRESSURE

Alarm Condition:

The chamber pressure transducer reads greater than 60 PSIA

Message Display:

HIGH CHAMBER PRESSURE

This alarm will turn off all digital outputs except for the alarm and Acknowledge Alarm lamp. The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present. All outputs remain off.

The alarm must be cleared by repair or replacement of the defective component. When the sensor returns to within the allowable range, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

VACUUM SYSTEM TIMEOUT

Alarm Condition:

The chamber pressure did not achieve the necessary vacuum level within 60 minutes.

Message Display:

VACUUM SYSTEM TIMEOUT

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present.

The alarm must be cleared by repair or replacement of the defective component. When the sensor returns to within the allowable range, the process will return to the condition when the alarm was activated. The Alarm Acknowledge lamp will extinguish.

LOW STERILIZATION TEMPERATURE

Alarm Condition:

The controlling temperature device reads less than one degree C ($1.0^{o}C$) than the set sterilization temperature for more than 10 seconds.

Message Display:

LOW STERILIZATION TEMPERATURE

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

The sterilization timer is reset to zero (0:00) minutes and the timer will not restart until the temperature is regained.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present.

The alarm will clear when the sensor returns to the set sterilization temperature. The Alarm Acknowledge lamp will extinguish.

HIGH STERILIZATION TEMPERATURE

Alarm Condition:

The controlling temperature device reads more than two degree C ($2.0^{o}C$) than the set sterilization temperature for more than 2 minutes.

Message Display:

HIGH STERILIZATION TEMPERATURE

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present.

The alarm will clear when the sensor returns to less than two degrees above the set sterilization temperature. The Alarm Acknowledge lamp will extinguish.

HIGH WATER LEVEL IN DRAIN

Alarm Condition:

The drain high water level switch (LS10) is on for more than 30 seconds

Message Display:

HIGH WATER

The fast exhaust valve shall open to clear the water from the drain. When the switch detects no water in the drain, the fast exhaust valve will close.

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. The Acknowledge Alarm lamp will stop flashing and remain illuminated if the alarm condition is still present.

The alarm will clear when the switch detects no water in the drain. The Alarm Acknowledge lamp will extinguish.

LEAK TEST FAILURE

Alarm Condition:

The chamber pressure rises above the allowable leak amount. The leak amount set point is determined by adding the chamber pressure at the start of the leak test to the allow able leak amount.

Message Display:

LEAK TEST FAILURE

The alarm will sound and the Acknowledge Alarm lamp will flash. It will also activate the alarm screen of the PanelView 900. The alarm shall be printed and the process will automatically advance to the air admission phase to end the cycle.

Operator Acknowledge:

Press the Acknowledge Alarm button to silence the alarm. Determine the cause of the lead and run another lead test cycle.

INPUT/OUTPUT LIST

NAME	DESIGNATION	MEMORY LOCATION
DOOR 1 NOT FULL OPEN	LS1A	I:1/0
DOOR 1 NOT FULL CLOSED	LS1B	I:1/1
DOOR 1 SAFETY SWITCH OK	PS11A	I:1/2
DOOR 1 SEALED	PS1	I:1/3
DOOR 2 NOT FULL OPEN	LS2A	I:1/4
DOOR 2 NOT FULL CLOSED	LS2B	I:1/5
DOOR 2 SAFETY SWITCH OK	PS11B	I:1/6
DOOR 2 SEALED	PS2	I:1/6
CHAMBER PRESSURE SWITCH	PS6	I:1/7
RUPTURE DISK FAILURE	PS4	I:1/8
EMERGENCY STOP	PB4D1	I:1/10
HIGH DRAIN WATER LEVEL	LT1	I:1/11
CONDENSER TEMP HIGH	TS1	I:1/12
VACUUM PUMP TRIPPED	MS3D2	I:1/13
120VAC POWER SUPPLY OK	N/A	I:1/14
OPEN DOOR	PB200	I:2/0
CLOSE DOOR	PS201	I:2/1
OPEN DOOR 2	PB202	I:2/2
CLOSE DOOR 2	PB203	I:2/3
ALARM ACKNOWLEDGE	PB204	I:2/4

Technical data

SLC 500 System Test General Specifications

The table below lists SLC 500 system test specifications.

Description	Specification	Industry Standard
Temperature	Operating: 0° C to +60° C (32° F to 140° F)	Not Applicable
	Storage: –40° C to +85° C (–40° F to 185° F)	Not Applicable
Humidity	5 to 95% without condensation	Not Applicable
Vibration	Operating: 1.0G @ 5 – 2000 Hz	Not Applicable
	Non-operating: 2.5Gs @ 5 – 2000 Hz	Not Applicable
Shock	Operating: (all modules except relay contact) 30.0Gs (3 pulses, 11 ms)	Not Applicable
	Operating: (relay contact modules – OW, IO combo) 10.0Gs (3 pulses, 11 ms)	Not Applicable
	Non-operating: 50.0Gs (3 pulses, 11 ms)	Not Applicable
Free Fall (drop test)	Portable, 2.268 kg (5 lbs) or less @ 0.762 m (30 in.) (six drops)	Not Applicable
	Portable, 2.268 kg (5 lbs) or more @ 0.1016 m (4 in.) (three flat drops)	Not Applicable
Electromagnetic Compatibility	Showering Arc: 1.5 KV	NEMA ICS 2-230/NEMA ICS 3-304
	Surge Withstand Capability: 3 KV	IEEE Std. 472-1974/ANSI C37.90/90A-1974
	Fast Transient Burst (impulse): 2Kv for 1746 power supplies, 1KV for 1746 I/O and communication lines over 10m (32.84 ft), 5 ns rise time	Internal Allen-Bradley standard ①
	Electrostatic Discharge (ESD): 15 Kv, 100 pF/1.5 Kohm model	Internal Allen-Bradley standard ①
	Radiated Electromagnetic Susceptibility: 5w walkie-talkie @ 464.5 MHz and 153.05 MHz	Internal Allen-Bradley standard ①
Safety	Dielectric Withstand: 1500V ac	UL 508, CSA C22.2 No. 142
	Isolation between Communication Circuits: 500V dc	Not Applicable
	Isolation between Backplane and I/Os: 1500V ac	Not Applicable
	Flammability and Electrical Ignition: UL94V-0	Not Applicable
Certification	UL listed/CSA approved Class 1, Groups A, B, C or D, Division 2 CE marked for all applicable directives	Not Applicable

① Internal Allen-Bradley standards are based on Allen-Bradley's extensive experience in industrial controls. It is also based partly on industry and/or military specifications.

Power Supply Specifications

Description	1746-P1	1746-P2	1746-P3	1746-P4
Line Voltage	85-132/170-265V ac 47-63 Hz	85-132/170-265V ac 47-63 Hz	19.2-28.8V dc	85-132/170-265V ac 47-63 Hz
Typical Line Power Requirement①	135 VA	180 VA	90 VA	240 VA
Maximum Inrush Current	20A	20A	20A	45A
Internal Current Capacity	2A at 5V dc 0.46A at 24V dc	5A at 5V dc 0.96A at 24V dc	3.6A at 5V dc 0.87A at 24V dc	10.0A at 5V dc 2.88A at 24V dc③
Fuse Protection②	1746-F1 or equivalent: 250V-3A Fuse Nagasawa ULCS-61ML-3 or BUSSMANN AGC 3	1746-F2 or equivalent: 250V-3A Fuse SANO SOC SD4 or BUSSMANN AGC 3	1746-F3 or equivalent: 125V-5A Fuse Nagasawa ULCS-61ML-5 or BUSSMAN AGC 5	Non-replaceable fuse is soldered in place.
24V dc User Power Current Capacity	200 mA	200 mA	Not Applicable	1A③
24V dc User Power Voltage Range	18-30V dc	18-30V dc	Not Applicable	20.4-27.6V dc
Ambient Operating Temperature Rating	0° C to 60° C (32° F to 140° F) (Current capacity derated 5% above 55° C)			0° C to 60° C (32° F to 140° F) no derating
Storage Temperature	–40° C to 85° C (–40° F to 185° F)			
Humidity Rating	5-95% (non-condensing)			
Wiring	two #14 AWG wires per terminal (maximum)			
Certification (when product or packaging is marked)	UL listed CSA certified CE marked for all applicable directives			
Hazardous Environment Certification	Class I Division 2			

① Refer to appendix F to determine line power requirements for your configuration.

② Power supply fuse is intended to guard against fire hazard due to short circuit conditions and may not protect the supply from damage under overload conditions.

③ The combination of all output power (5 volt backplane, 24 volt backplane, and 24 volt user source) cannot exceed 70 Watts.

6. STERILIZER SPECIFICATION

7. P&I DIAGRAM

8. ELECTRIC WIRING

9. INSTALLATION DRAWING

10. PHASE LIST

11. COMPONENTS

Illustration on drawings

- Electric wiring diagrams are drawn with power off.
- Apparatus and components are illustrated in their basic position.
- Pressure switches are illustrated in the position they take for atmospheric pressure.
- Thermal switches are illustrated in the position they take for room temperature.

Departure from these rules are indicated on the diagrams.

Panel-Mounted Thermal Printer, Model PRNTR0001

The Getinge panel printer is a completely maintenance-free thermal printer, specially developed to withstand the severe conditions associated with front mounting. The thermal paper has been specially developed for the Getinge panel printer in order to withstand particularly severe requirements in respect of heat resistance, resistance to fading and permanent documentation.

Loading the paper

Use only genuine Getinge paper for the best printout durability.

The thermal paper is of high quality, supplied on 50 mm (2”) diameter rolls with a width of 60 mm (2.4”).

Do not replace the paper without being properly grounded. If not, static electricity can destroy the microprocessor if you touch it, or any of the connections.

- Turn off the control unit power supply switch. The printer lamp goes out.
- Pull the upper edge of the transparent paper collector outwards in order to release it.
- Release the black printer cover in the same way and remove the old paper roll.
- Load a new roll of paper with the tongue upwards, as shown in Figure 1. This will automatically position the recording side correctly in the printer.
- Position the roll correctly, pull out some of it and close the printer cover so that it clicks into position.
- Turn on the sterilizer control power supply switch and feed out about 10 mm (1/2”) of paper using the paper feed pushbutton on the printer. Refer to Figure 2. Check that the paper is being fed correctly through the opening in the printer cover.
- Lift the paper collector into position. The printer is ready for use.

Operation

- Data is recorded automatically as the cycle progresses. The steady red light on the lower left of the front panel indicates the power is on and the printer is functioning normal.
- When the red light is flashing, a fault is indicated. The typical fault is when the printer is out of paper. To check the paper, refer to the Paper Loading section above. If the printer is not out of paper and the red light continues to flash, call for service.
- To retrieve the printed record at the end of a cycle, depress the feed button on the lower right front panel. Paper will continue to feed as long as the button is depressed. When desired paper length is attained, remove the paper utilizing the “tear bar” of printer.

Maintenance

- In addition to adding paper, the only maintenance required is occasional cleaning of the thermal print head located immediately above the printer rubber roller. In general, the print head should be cleaned after every 10 rolls of paper.
- To clean the print head, refer to the Loading Paper section above. With the printer door in its horizontal position, locate the print head. This is a tan colored strip positioned immediately above the rubber roller. Clean the print head by swiping several times with a cotton swab and isopropyl alcohol or commercially available thermal print head cleaning pads.
- Be sure print head is dry before closing the printer door and plastic cover

Replacement Parts

FIGURE 1

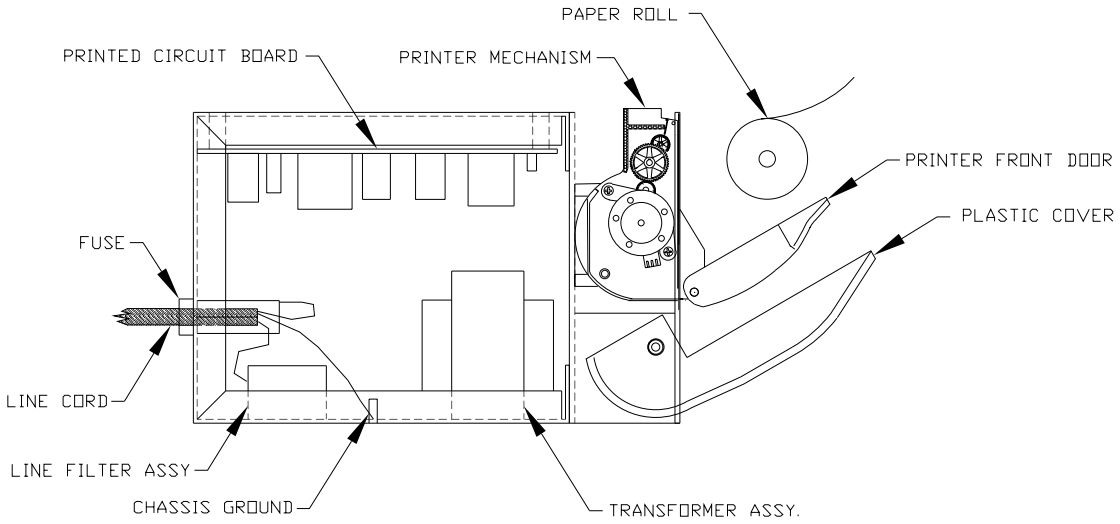
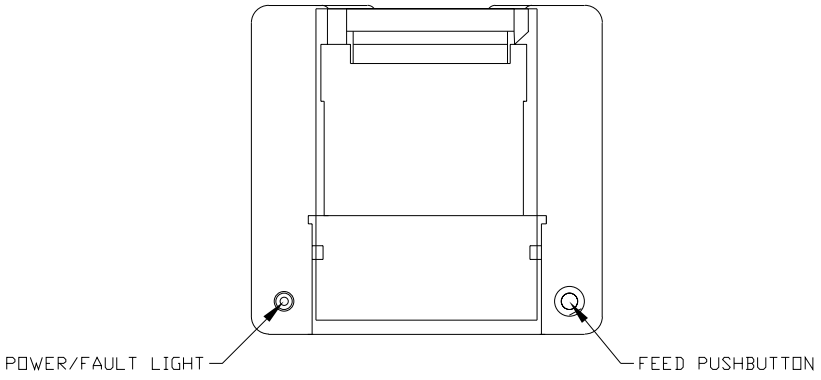


FIGURE 2



Fuse Replacement: Please follow these instructions for proper fuse replacement.

- Disconnect power from the unit
- Push in fuse holder and turn to remove for replacement.
- Once replaced, re-insert fuse holder by pushing in and turning simultaneously.

PART NUMBERS FOR MAJOR COMPONENTS:

Description	***Part Number***
PRINTER MECHANISM	PRNME0001
PRINTER CIRCUIT BOARD	PRNCB0001
TRANSFORMER ASSEMBLY	PRNTR0001
LINE FILTER ASSEMBLY	PRNFA0001
PRINTER FRONT DOOR	PRNDR0001
PLASTIC COVER	PRNCO0001
PAPER ROLL	PRNPA0001
POWER/FAULT LIGHT	PRNLT0001
FEED PUSH BUTTON	PRNBU0001
FUSE LAMP, 3AG	PRNFU0001

Specification:

Description	*Value*
NUMBER OF COLUMNS	24,42
THROUGHPUT	240 CPS
BUFFER SIZE	8 / K
PRINT MODE	THERMAL DIRECT 192 DPI
PRINT SPEED/SLEW SPEED	1 IN/SEC
PRINT LINE	56 mm
PAPER WIDTH	60 mm
PAPER ROLL SIZE	50 mm
OPERATING TEMPERATURE	0 TO 50 ^{O}C
PRINT HEAD LIFE	30 KILOMETERS

Interface Information:

Description	*Value*
SERIAL	STANDARD RS-232C
BAUD RATES	SELECTABLE 300 OR 9600
DATA FLOW CONTROL	XON/XOFF OR BUSY/READY
POWER	110V, 50/60Hz, 0.2A 24V, 50/60Hz,0.83A

Vacuum pump LEM 60

Item No.	Voltage	Hz	Hp
PUMP0039	208/230/460	60	3

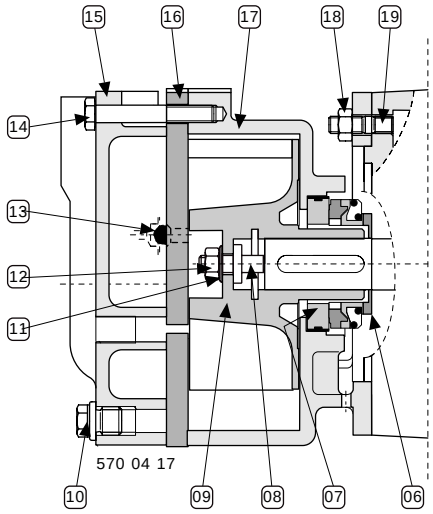
The direct on line starter cut out current, should be set to the value given by the motor data plate.

Sealing water flow: 1 litre (.3 gal)/ 12 sec.

Air is supplied via an adjustable throttle valve to the pump.

Servicing

The following instructions are intended to assist all work that requires the pump to be dismantled.



6	Spacer	4	Pump end cover
7	Mechanical seal	14	Screw
8	Adjustment screw	15	Pump end cover
9	Impeller	16	Guide plate
10	Plug	17	Pump casing
11	Washer	18	Nut
12	Locknut	19	Stud
13	Valve globe		

Preparation

Switch off and lock the sterilizer safety switch prior to working on the sterilizer.

1. Remove all pipes connected to the pump.
2. Mark and remove the motor leads.
3. Loose the pump stand bolts and remove the pump.

Dismantling

1. Stand the pump on the motor fan cage with the shaft in vertical position and remove the connection plate attachment screws (14).
2. Separate the connection plate (15) together with the guide plate (16) from the pump housing (17) by prying in the centre-groove with, for instance, a screw driver. *Take care of the plastic globes (13).*
3. Unscrew the counter nut (12).
4. Pull off the impeller (9) using either method a or b below, or a combination of these.
   a. Unscrew the adjustment screw (8) completely out of the shaft.
   b. Remove the motor flange attachment screws (18). With symmetrically applied levers, prying off the pump housing (17) so that the latter serves as a puller for the impeller. Use a puller if needed.
5. Do not use a hammer but press away smoothly the shaft seal sliding ring (7) in case it has to be replaced.

Reassembling

Prior to reassembling, all parts should be thoroughly cleaned and inspected. Special attention should be paid to sealing-surfaces with regard to wear and scratches.

1. Place the pump on the fan cage as when dismantling.
2. Place the movable part of the shaft seal (7) concentrically around the shaft with the carbon seal ring facing upwards.
3. If the shaft seal (7) has been removed, apply soapy water to its rubber edge, turn it with the rubbing surface towards you and press it into position manually in the pump housing (17)
4. Fit the pump housing (17). Turn it until its centre is at minimum distance to the pump stand and tighten the screws.
5. Screw home the adjusting screw (8) completely into the shaft and fit the impeller (9) with washer (11) and nut (12) so as to form a clearance space of 0.10 - 0.12 mm between the impeller and the

guide plate (16). Lock the screw with the nut (12) without displacing the axial position of the impeller.

6. Apply a high viscous, semi-drying sealing compound such as Epple 33, Permatex or similar on the sealing surfaces of the pump housing (17) and the connection end plate (15). Fit the guide plate (16) including the valve globes (13) and the connection end plate and tighten the attachment screws (14).
7. Bring, at the fan end, the shaft to rotate and check it for a smooth noiseless running.

Loosening a seized pump shaft

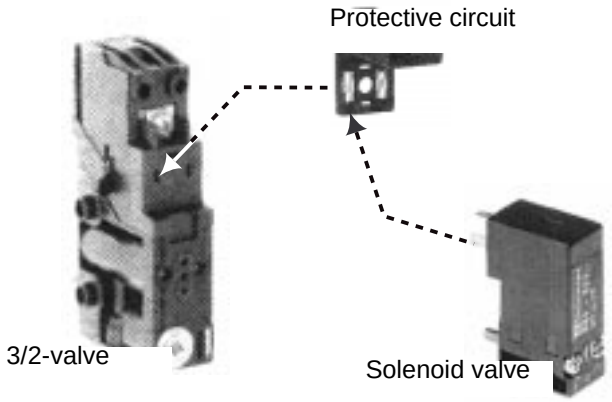
It has been reported that the shaft of a vacuum or feed water pump due to the fine clearances may become too tight after standing for a period without use. The motor will then not rotate when switched on. In this case, proceed as follows:

Switch off mains at the safety switch and lock.

- Remove the fan hood of the pump motor.
- Pry off the fan with two symmetrically applied levers (for example large screw drivers).
- Protect the shaft with a folded piece of sheet metal when applying a pipe wrench. Twist in both directions to loosen.
- If this procedure fails to loosen the shaft then:
- Loosen the screws, holding the pump housing together, about one turn.
- Make another attempt to loosen the shaft.
- If required, tap carefully on the loosened housing.
- Tighten the screws, in rotation checking that the shaft is free to rotate.

Reset the lockable switch and check by brief manual operation of the contactor that the pump works normally.

Solenoid valve block



Integral parts

Solenoid valve block	
3/2-valve with Solenoid	VALTE0010
Protective circuit/ LED	INDIC0007

The 3/2-valve
is equipped with an pneumatic indicator showing white on normally closed modules and red on normally open ones.

The protective circuit
has a signal light showing power on to the valve block.

The solenoid valve
has a knob with which the valve can be operated manually. The valve is manually activated in position ”I” while it is operated by the control system in position ”O”

Piston valves

Piston valves are used for various media as shut-off valves or as control valves with an on/off function. Such valves are normally maintenance-free, and so any maintenance or replacement is determined by long-term wear or by seal damage.

- Wear and tear can give rise to leakage in the actuator seal, the sleeve seals of the stainless steel pipe or in the valve body stem seal.
  If the valve is otherwise in good condition, such leakage can be cured by a renovation set.

Always replace seals, including any face seals in connections when dismantling the valves.

- Wear and tear in the valve actuator will give rise to leakage of compressed air to the surroundings. Leakage into the valve body and its media is prevented by a vent hole in the stainless steel guide tube.
- Wear and tear of the stainless steel pipe sleeve couplings can give rise to leakage between that part of the valve body that is connected to the top of the valve stem and the vent hole in the stainless steel pipe sleeve.
  Depending on how the valve is connected, such leakage can be detected by means of a leak test of the sterilizer or by leakage of media through the hole.
- Damage to, or dirt on, the valve body stem seal can cause leakage between the inlet and outlet sides of the valve. If the valve is connected to the sterilizer chamber, the easiest way to detect such leakage is by means of a leak test of the sterilizer.

Pressurise the actuator with compressed air when removing the valve body to replace the stem seal. This will compress the closing spring.

Beware of the risk of injury when removing the valve body or actuator, as both contain compressed springs.

PT-100 Sensors (RTD)

Metal parts: Acid proof stainless steel (AISI 316 or similar).

Operating temperature: 0 - 140°C.

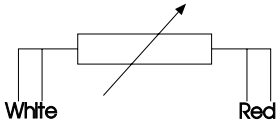
Operating pressure: -1 to +3 bar(e).

Standard: IEC 751-1983 Class A, 4 wire unit.

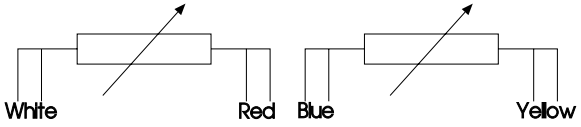
Model	Cable		Type	Conn.	Steel tube		
	Material (*	Length			Length	Dia.	Type
CONEQ0132	Silicon- rubber	8 m	Single	Fig 1	150 mm	3 mm	Bended
CONEQ0131	Silicon- rubber	8 m	Single	Fig 1	150 mm	3 mm	Straight
CONEQ0130	PVC	3 m	Single	Fig 1	120 mm	2.5 mm	Bended
CONEQ0134	Silicon- rubber	8 m	Double	Fig 2	120 mm	3 mm	Bended
CONEQ0133	PVC	2 x 5 m	Double	Fig 1	120 mm	3 mm	Straight

*) Silicon-rubber cables are designed for locations inside the sterilizer chamber.

PVC-cables are designed for wireing outside the sterilizer chamber only. (Max. ambient temperature 90°C).



Pic. 1



Pic. 2

Soldered plate heat exchangers

The performance of the plate heat exchangers is vital for correct operation of the sterilizer. Poor heat exchanger performance will automatically reduce the vacuum suction performance of the vacuum pump. This will, in turn, extend process times or, in the worst case, cause the process to fail, due to failure to reach the required vacuum conditions. In addition, poor vacuum pump performance can cause drying-out and thus indirectly overheating of the load, one of the effects of which would be to put the validation performance of the sterilizer at risk.

The plate heat exchangers normally require no maintenance, apart from possibly removing lime about every second year. If the water hardness exceeds 4 °dH, it may be necessary to clean the heat exchangers more often.

Blockage by lime generally tends to obstruct the cooling water inlet of the final heat exchanger first. Inspection there will therefore provide a good indication of the condition of the cooling system. The final heat exchanger is the one from which the discharge from the sterilizer emerges. Even though the heat exchangers may not be blocked, even modest deposits of lime can reduce their efficiency, and so regular cleaning is still recommended.

When they have been cleaned, the heat exchangers should also be pressure-tested. During normal operation, the pump circuit is under vacuum, while the cooling circuit is pressurised, which would mean that any leaks would reduce the performance of the vacuum pump. In addition, hygienic aspects must be considered. Pressure testing will reveal any leakage.

Cleaning

A cleaning solution suitable for cleaning lime deposits, but safe for use in the heat exchanger, shall be utilized.

Clean the heat exchangers as follows:

- Dismantle the heat exchanger.
- Read the instructions for using the cleaner and dilute it as instructed.
- The cleaning solution should be heated to about 135 °F for best effect. Alternatively, the heat exchanger can be filled with the cleaner and then heated up.
- Fill the heat exchanger with the diluted (and possibly heated) cleaning solution.
- Allow the solution to act for a few minutes if there is lime that is to be removed.
- Follow the instructions for handling, waiting time, emptying and rinsing of the cleaning solution.

In emergency, an alternative method can be used:

- Remove the heat exchanger.

- Place the heat exchanger in a cleaning bath containing one of the acids listed below. If the positions of the connections allow this, the heat exchanger can instead be filled with one of the acids below.
  - 5% phosphoric acid
  - 5% oxalic acid
  - 10% citric acid

Do not use other acids or other concentrations than those listed above.

Working with acids may be dangerous. Follow the instructions and safety regulations of the chemical suppliers.

- Make sure that the heat exchanger is completely filled with liquid. Leave the heat exchanger in the bath for about one hour.
- Empty the heat exchanger and rinse it immediately with water.
- If the heat exchanger is heavily scaled, the treatment may need to be repeated. IF this happens, consider reducing the time between descaling operations.

Always fit new gaskets to avoid leakage after having removed the connections to the heat exchangers.

Pressure testing

- Pressure-test each heat exchanger individually under water at a pressure of 43 to 85 psig (3-6 bar(e)). Pressure-test one side and check to see that water is not leaking out through the connections on the other side, or through the brazed joints.

Use only water as the pressure-testing medium, and do not exceed a pressure of 10 bar(e) when testing.

After cleaning, swap the two small heat exchangers round so that the one that was first in the liquid flow is last. This facilitates self-cleaning of the heat exchangers.

Flow control

The flow through the cooling system should always be checked when the system is cleaned, as well as performing such a check occasionally in its own right.

Checking the flow rate through the heat exchangers will reveal not only clogging of the heat exchangers but also dirt in filters, choke washers or the cooling water valve. If flow control does not come up to performance, it indicates that the cooling is inefficient and that the cooling system needs to be cleaned. The symptoms are the same as those mentioned above.

Perform a flow check with the sterilizer in the standby mode.

- Connect a hose to the sterilizer cooling water outlet and find a suitable collection vessel with a capacity of 10 litres.
- Open the valve for minimum cooling of the condenser by a manual instruction from the operator's control panel. See also the PACS 2000 CONTROL UNIT chapter.
- Use a stop watch to measure the time taken to fill the vessel, and then calculate the flow rate.
- Repeat this procedure with the maximum cooling valve.
- Compare the measured flow rate with the values shown in the table below. A capacity reduction of 10 % relative to the value shown in the table can be accepted. The values shown in the table may be exceeded if the water pressure is higher than specified.

INDEX

A
After commissioning 2
After the first month of operation . . 2
Air filter sterilization program 5

C
Checking and adjusting the door position 2
closing force 2
Connecting the printer to the control system 5

D
door seal 5

E
Emergency stop button 9
Every six month 3
Every three months 2

F
Fault with an analog transducer . . . 2
Fitting an ink ribbon 3

G
General 1

M
Manual control by actuating the control valves 3
Manual interference in the sterilizing process 1
Manual stepping with key switch . . 1
Media to chamber 2
Monthly 2

O
Once a year 3
Open the door manually 4

P
Piston valves 16
Plate heat exchangers 18
Pressure transducer fault 2
Preventative Maintenance Schedule 7
Printer Epson LX 300 2
Prior to Commissioning 1
PT-100 Sensors (RTD) 17

S
Safety blocking of the start function and the medium admittance to chamber 7
Safety Check 2
Safety check 10
Safety check, door lock and pneumatic limit switch 8
Safety check, electric limit switch . 9
Safety components 1
Safety devices, a survey 1
Seal between door and chamber . . . 1
self-test function of the printer 9
Sensor fault, independent system . . 3
Service 6
Solenoid valve block 15
Spare parts 6
Squeeze protection and door motion 2

T
Temperature Sensor fault 2
Timing belt replacement 7

U
Unpacking and setting up the printer 2

V
Vacuum pump LEM 170 12